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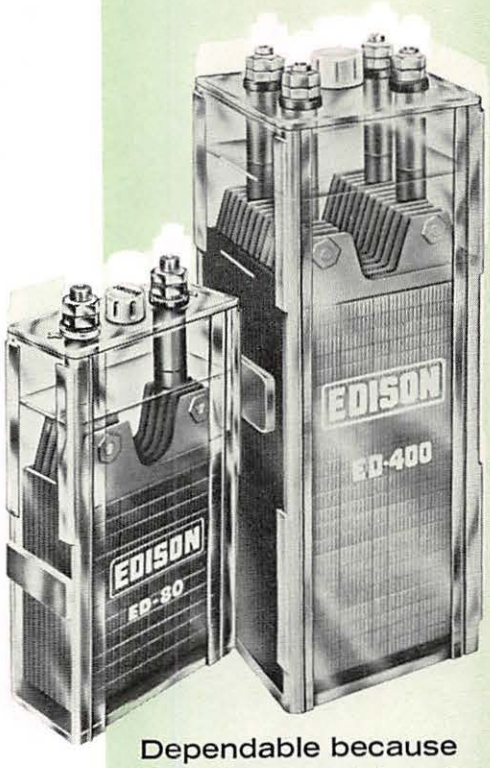

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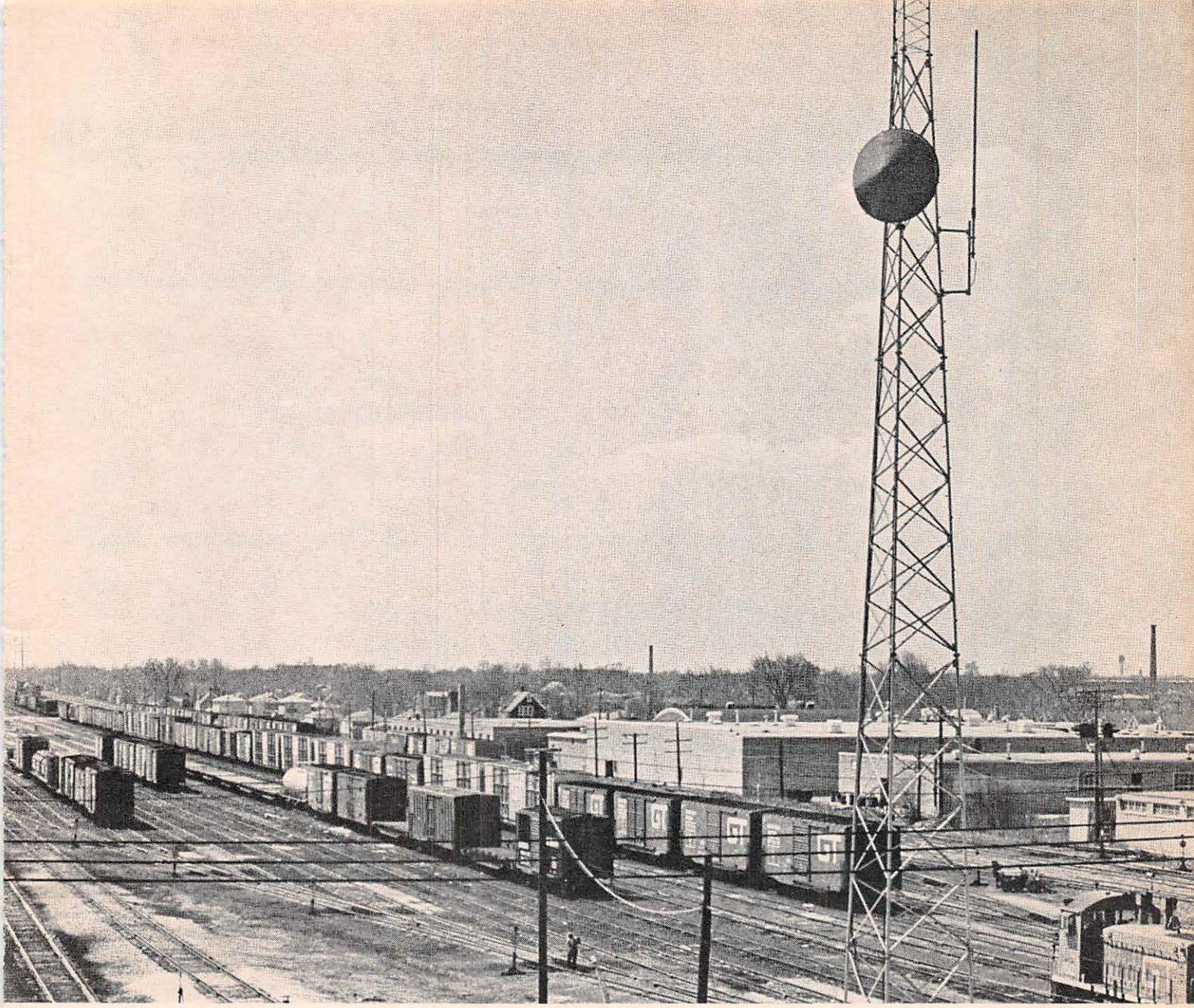

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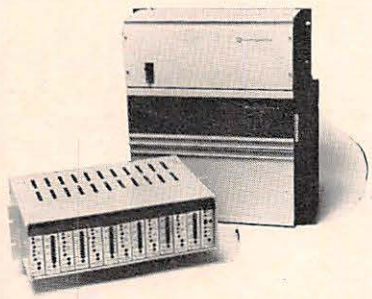

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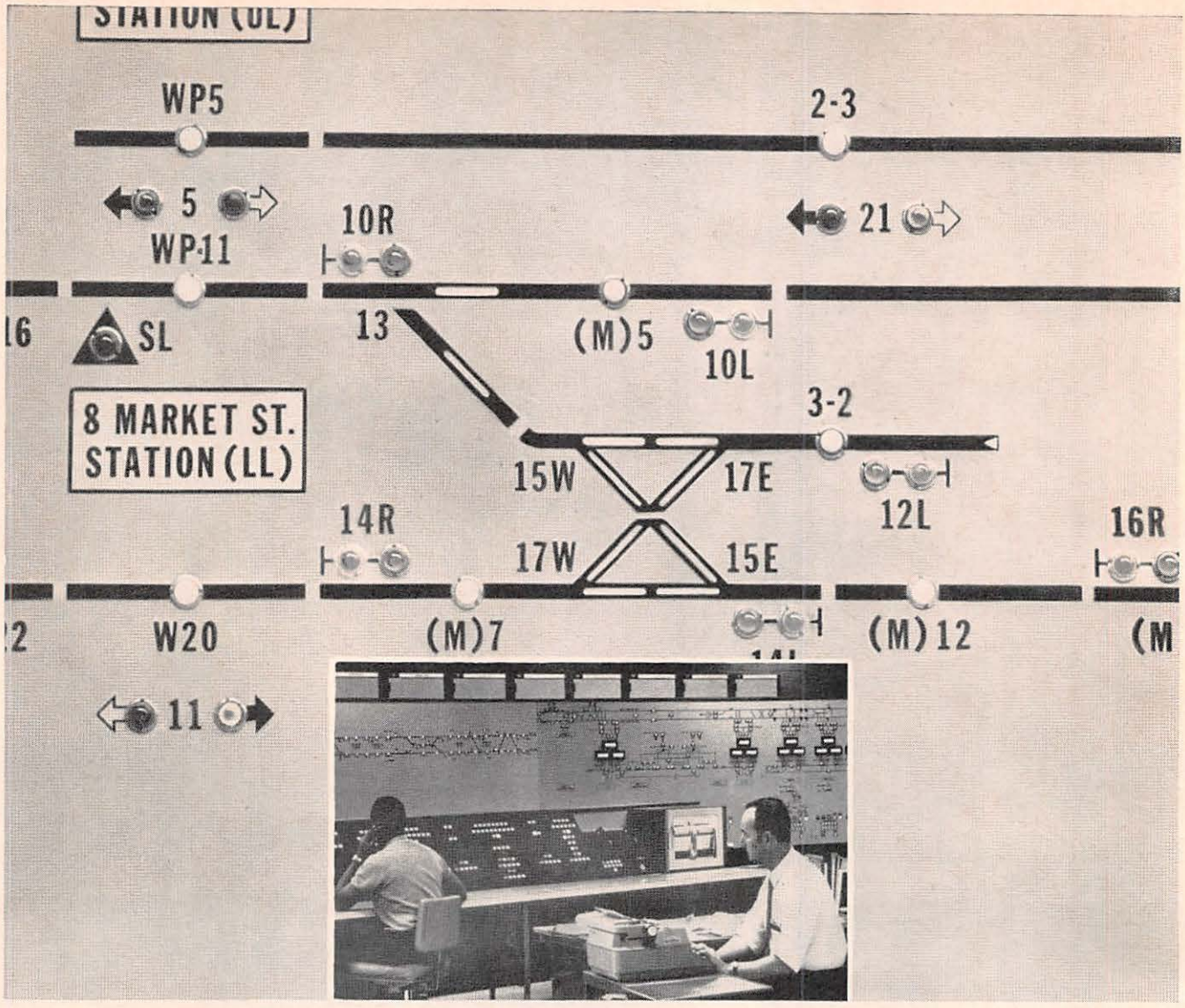

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APRIL 1975 Vol. 6 No. 4

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FEATURED THIS MONTH:

MoPac gives a new face to CTC 14

AAR Signal Training Bulletin D-1 20

Electrical Noise: Get it out of the signal plant 24

DEPARTMENTS:

Industry News 8

RSC News 10

Letters 13

Publications 13

People 22

50 Years Ago in Railway Signaling 29

Product News 30

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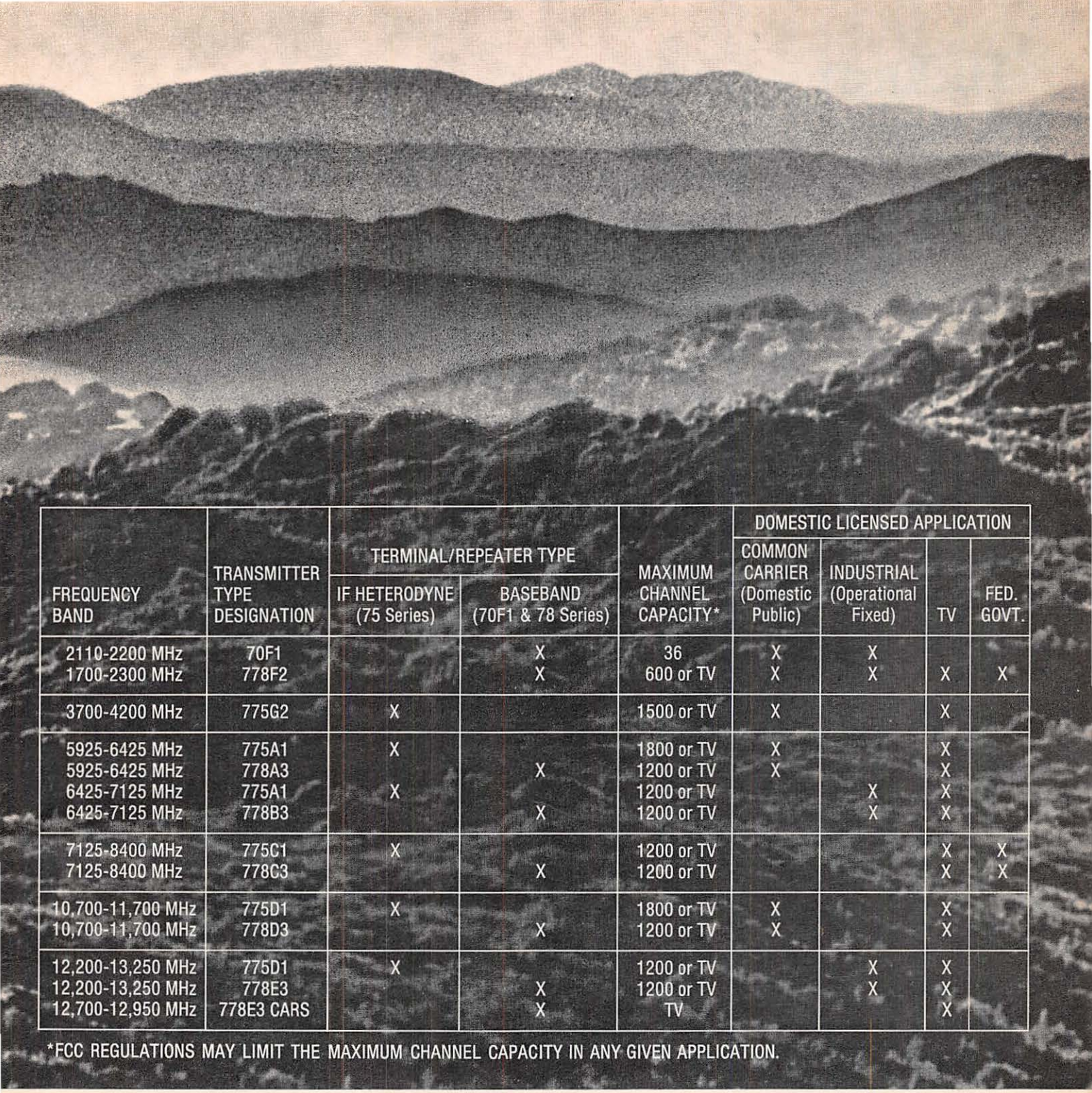

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		IF HETERODYNE (75 Series)	BASEBAND (70F1 & 78 Series)		COMMON CARRIER (Domestic Public)	INDUSTRIAL (Operational Fixed)	TV	FED. GOVT.
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1700-2300 MHz	778F2		X	600 or TV	X	X	X	X
3700-4200 MHz	775G2	X		1500 or TV	X		X	
5925-6425 MHz	775A1	X		1800 or TV	X		X	
5925-6425 MHz	778A3		X	1200 or TV	X		X	
6425-7125 MHz	775A1	X		1200 or TV		X	X	
6425-7125 MHz	778B3		X	1200 or TV		X	X	
7125-8400 MHz	775C1	X		1200 or TV			X	X
7125-8400 MHz	778C3		X	1200 or TV			X	X
10,700-11,700 MHz	775D1	X		1800 or TV	X		X	
10,700-11,700 MHz	778D3		X	1200 or TV	X		X	
12,200-13,250 MHz	775D1	X		1200 or TV		X	X	
12,200-13,250 MHz	778E3		X	1200 or TV		X	X	
12,700-12,950 MHz	778E3 CARS		X	TV			X	

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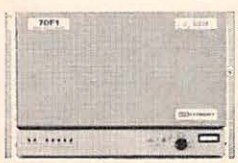

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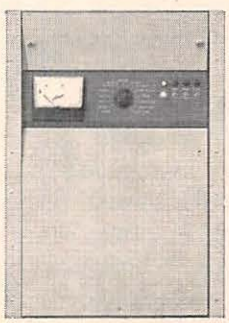

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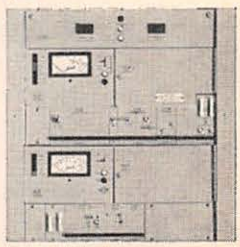


GTE LENKURT

Industry news

. . . a quick look at current events throughout the railroad industry

What will the 94th Congress do to help railroads out of their present crisis? Half a dozen proposals are already before the House Interstate and Foreign Comerce Committee—and more are on the way. Hearings will start in June. By this fall, it's likely that an omnibus bill will have been developed, incorporating features of several different proposals. Among the current proposals are these: Congressman Brock Adams' revised Surface Transportation Act, which is in many ways similar to the STA which narrowly failed to pass last year. Its main features is provision of $2 billion in Federally-guaranteed loans for railroad track and rolling stock improvements. Another bill before the House calls for creation of an Interstate Railroad Corporation which would take over, rebuild and maintain certain "essential" railroad rights-of-way—much as the Federal government now maintains the Interstate Highway System. Private railroads would use these tracks on a user-charge basis. Still another bill proposes the creation of a WPA-like work force to rehabilitate rights-of-way, with the government making outright grants of $2.5 billion to hire presently-unemployed workers for this purpose. And there are several plans for railroad trust funds financed by a surcharge on freight shipments. Also in the works is a bill which will propose a unified Transportation Trust Fund, incorporating monies now being spent on highways, waterways, and (to a small extent) railroads. Implementation of this idea would mean more Federal funds for railroads, and less for the highways and waterways.

Recession notes: Class I railroad employment, which began to rise in 1974 after years of decline, is now on the way down again. The ICC reports that railroads employed an average of 502,952 persons in mid February. This represented a drop of 2.62% from January—and a drop of 2.64% from a year ago . . . . The employment reduction results from the severe drop in traffic which railroads are experiencing. Ton-miles are down nearly 15% from last year's record levels. This means that much equipment is now idle (AAR President Stephen Ailes recently estimated that 70,000 freight cars were in storage). It has also meant a drop in orders for new cars. In February, only 2,031 new cars were ordered—compared with 6,371 in February a year ago.

Bucking the recessionary trend is the Chessie System. Coal remains big in the railroad traffic picture—and the Chessie remains big in coal. Many railroads are pulling back, at least temporarily, on capital investment plans for 1975; but on March 27, Chessie System President John W. Hanifin announced a two-year, $525-million equipment program for 1975-76. Most of this will be spent for 16,000 100-ton-capacity coal hopper cars, costing $409 million—of which 10,000 are being built at Chessie's Raceland, Ky., shops. The other 6,000 cars will be split evenly between Pullman-Standard and ACF Industries. Chessie's program also calls for 3,200 merchandise freight cars, costing $77 million; 100 new diesel-electrics, costing $35 million; and 97 all-steel cabooses, valued at $3.4 million

Approach and Island Frequency Shift Overlay Track Circuits

FOR HIGHWAY CROSSING PROTECTION

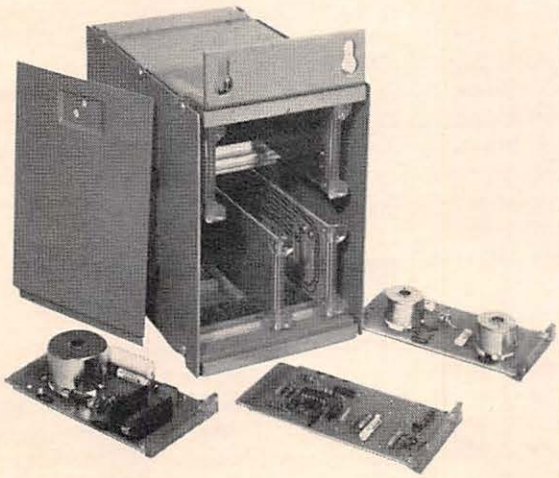
GRS approach and island frequency shift overlay (FSO) track circuits have unprecedented immunity to noise and interference – also, insulated joints are not required. Approach FSO track circuits, up to 6000 feet long, are available in 15 mutually compatible channels ranging from 618 Hz to 11.43 KHz. Island FSO track circuits, from 60 to 300 feet long, are available in 3 mutually compatible channels ranging from 13.8 to 20.9 KHz.

Major features and options for approach and island FSO include:

- Selection of transmitter output power – 600, 400, or 200 milliwatts.
- Plug-in power unit – increases approach FSO transmitter output to 4 watts.
- Five-way mounting – shelf-mounted, wall-mounted any of three ways, or rack-mounted in a Type B2 relay space.
- Centralized equipment location – approach FSO transmitter and receiver can both be mounted in the same wayside case and use the same power supply.

Also available is a new GRS insulated joint bypass unit which effectively passes all approach frequencies and causes only a minimum reduction in track circuit length.

Conveniently located AAR terminal posts provide for track, power, relay and ground connections.



Frequency determining elements are on three printed circuit boards – simply replace these boards to change a frequency channel.

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RSC News

BR's test car is checking new communication systems

British Rail's latest mobile laboratory, named Iris, is being kept in the dark for the first part of its journey on the railway by operating mainly in tunnels.

Formerly used for local passenger service in the Bletchley, Buckingham Banbury area, Iris has been equipped by BR's Research & Development Division to carry out radio system survey work anywhere on the network.

Its first task is to evaluate the performance of a possible system of track-to-train communication which overcomes the loss of signal problems experienced with normal radio links, particularly in tunnels. Various communication links are being evaluated as part of the work on systems to provide drivers with information about the running of their trains as additional aids to safety and efficiency.

One of the most promising systems being evaluated is the use of lineside radiating cables. These cables are fed with radio signals at one end which are then allowed to "leak" out of the cable all along its length. Receivers on board moving trains can then detect the low level signal along the entire cable. The radiating cable is a coaxial transmission line with a special outer sheathing. By suitable design a cable can be made to radiate a sufficient amount of power to allow communications within a short distance of the cable.

Iris is the latest mobile laboratory to be designed by the Train Control Project team at the Railway Technical Center, Derby. It is powered by two 150 hp six cylinder diesel engines and has a maximum speed of 75 mph. Iris has been equipped to make field strength measurements for both radiating cable and free space radio propagation surveys. Basic instrumentation comprises a Singer Stoddart field strength meter and a Wang programmable calculator which provides on-board analysis of results as they are obtained. Data recording equipment is also available for making further analysis of the information.

In the tests 1,640 ft. lengths of cable are being mounted in one of the tunnels on the Research & Development Division's test track near Nottingham. During the current test program different cables will be mounted in various positions within the tunnel and Iris will carry out a series of runs measuring and recording the field strengths along the cable. Tests will be made using signal frequencies ranging from 40 MHz to 460 MHz.

From the results a clear picture of the propagation characteristics of various types of cables, at different frequencies and locations within the tunnels will be obtained to supplement future work on the use of such cables in other applications.

CTA completes more cab signaling

Cab signaling work has been completed on the Chicago Transit Authority's heavily traveled North-South elevated route. Meanwhile, the CTA is pressing forward with a $12-million project for installing cab signaling by next January on three remaining rapid transit routes—Ravenswood, Evanston-Wilmette and Skokie Swift. Completion of work on these three remaining routes will mean that the CTA's entire 192 miles of rapid transit will be protected by cab signaling.

An accelerated program for installing cab signaling on the North-South "L" route, as well as on the three remaining routes, was instituted last summer at the direction of Milton Pikarsky, then CTA Chairman and now Chairman of the Regional Transportation Authority. At Pikarsky's direction, the contract timetable for installing cab signaling on the Ravenswood, Evanston-Wilmette and Skokie Swift routes was reduced by a full year—to 18 months from 30 months as originally planned.

As now scheduled under a contract with General Railway Signal Co., the installation of cab signaling equipment on trains and at wayside on these three routes is to be completed by next Jan. 17.

The completed North-South "L" cab signaling which cost $10.5 million, and the current Ravenswood, Evanston-Wilmette and Skokie Swift installation projects are part of a $25-million signaling phase of a CTA modernization program costing approximately $148-million. Two-thirds of the cost of this program is being funded by the federal government's Urban Mass Transportation Administration and one-third by the Illinois Department of Transportation.

DSD annual meeting will follow C&S meeting

Immediately after the closing session of the 1975 annual meeting of the Communication and Signal Section, AAR, in New Orleans, La. which is slated for Sept. 15-17, the AAR Data Systems Division will commence its Eleventh Annual Meeting at the Fairmont Hotel on Wednesday-Thursday and Friday, Sept. 17-19.

DW&P awards contract for 229 mile microwave system

The Duluth, Winnipeg & Pacific has awarded a contract to Motorola Communications and Electronics, Inc. for a 229 mile, 17 hop microwave system. The system backbone will run between Duluth and International Falls, Minn., and will utilize MR200 and MR600 RF equipment. MC400 Multiplex will provide the road with voice and data channels. Main tower locations will be equipped with MICOR radio base stations to provide full VHF coverage.

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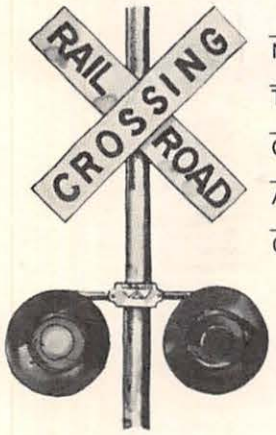

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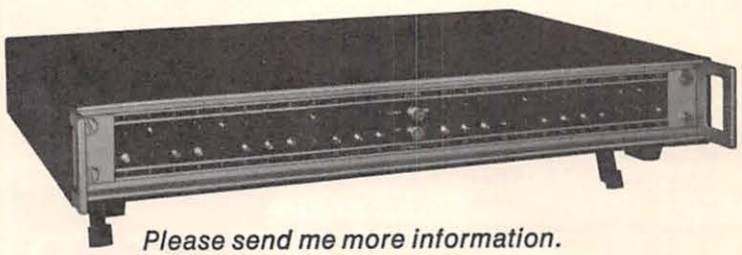

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Letters

Twelve-inch roundel

St. Louis, Mo.

To the Editor:

This refers to the editorial "Twelve inch roundel too hot to touch?" in the Nov./Dec., 1974 issue of Railway System Controls.

I was one of those who vocally opposed the inclusion of 12-inch roundels as an Alternate Requisite in the proposed revision of Manual Part 166. My basis was that it had not been determined that the 12-inch roundel is more effective than the 8⅜-inch roundel and that its use would create a number of problems. My feeling was and is that inclusion of 12-inch roundels in the specification is premature and that the effectiveness must be determined before the roundel is approved as a recommended practice.

J. L. Weatherby
S&C Engr., MoPac

Shorter labels

Hicksville, N.Y.

To the Editor:

Your articles on automatic car identification in the February issue of RSC were excellent, and gave your readers a very well done run-down on several of the papers presented during the Atlanta meeting of the Data Systems Division on progress of aci.

I would like to clarify one possible point of misinterpretation which appeared in the portion "Shorter labels?" in which you quoted from my paper. Earlier during my talk, I mentioned that there were two distinct areas of testing—one of which was sponsored by the Association of American Railroads' Research and Development Department and was concerned only with possible techniques of relocation of labels on all types of flat cars to get the labels up higher on the car and further into the angle of scan. The second test series was concerned with independent work attempting to assist in resolution of the overall dirty label and marginal label problems. This second series of tests was not sponsored by the AAR, although they were aware of our activity, and was cooperatively done by Servo, Info Inc., Santa Fe, and the Chessie System.

Although the photograph used in your article accurately shows all three sizes of labels, it actually represents two different test periods. The ½-size label was developed for possible use by the AAR on flat car equipment and was suggested as one alternate approach to the test problem covered under AAR sponsorship. The diminished size label, which was finally selected during the second, independent testing, as the best for future service tests is now being tested on an accelerated life test basis by the Santa Fe and Chessie System in dedicated, non-interchange TOFC/COFC service.

Since it was necessary for the independent tests to be completed before a decision would be made whether or not to submit the diminished size label to the AAR for full service tests by all railroads, I wanted to make it clear to your readers that only the ½-size label, which was not considered suitable for unrestricted railroad use, fell under the AAR test support period. The paragraph you quoted is correct, but must be read as a part of the complete talk to tie the two separate, but related test series together.

Thanks again for your fine work in support of automatic car identification, and I hope they assist in getting more positive action on aci on the part of North American railroads.

W. E. Trantham
Dir. Gov. Opers.
Servo Corp. of America

Publications

Cushman Electronics, Inc. Transmission Test Instruments for multiplex systems are described in a new 8-page, 4-color brochure. The test instruments consist of Model CE-21A frequency selective levelmeter, CE-23A spectrum display, and the CE-26A signal generator. *Cushman Electronics, Inc.*

Circle 101 on reader service card

Hollingsworth Solderless Terminal Co. has just published a new fully illustrated 64-page catalog on its expanded line of insulated and non-insulated terminals, connectors and splices. The catalog includes a new "funnel entry" terminal, designed to minimize strand turnback and increase termination speed and reliability. Also featured is a new line of slip-on terminals for wire sizes 26-10 AWG, and new high temperature terminals for 650 degrees F. and 900 degrees F. applications. *Hollingsworth Solderless Terminal Co.*

Circle 102 on reader service card

A 44-page booklet covering the 948A Repeater and Order Wire Assemblies is now available from GTE Lenkurt Inc. The 948A is a complete lineup of low cost repeaters, power supplies, repeater cabinets, test equipment and order wire assemblies for N-type carrier systems. Designed for use with GTE Lenkurt 46B, 47A/N1 and 47A/N2 cable carrier systems and equivalent systems, the 948A provides line operation for toll, intertoll and exchange applications on spans up to 200 miles in length. *GTE Lenkurt Inc.*

Circle 103 on reader service card

A 92-page booklet that describes the configurations, software and peripherals of the HP 3000CX Mini DataCenters is now available from Hewlett-Packard Co. The booklet details the four new interactive minicomputer systems designed for business, scientific/engineering, timesharing and real-time applications. The Mini DataCenters have a common operating system that features spooling, virtual memory and a communications subsystem to link CX Series systems to each other and to larger computers as well. *Hewlett-Packard Co.*

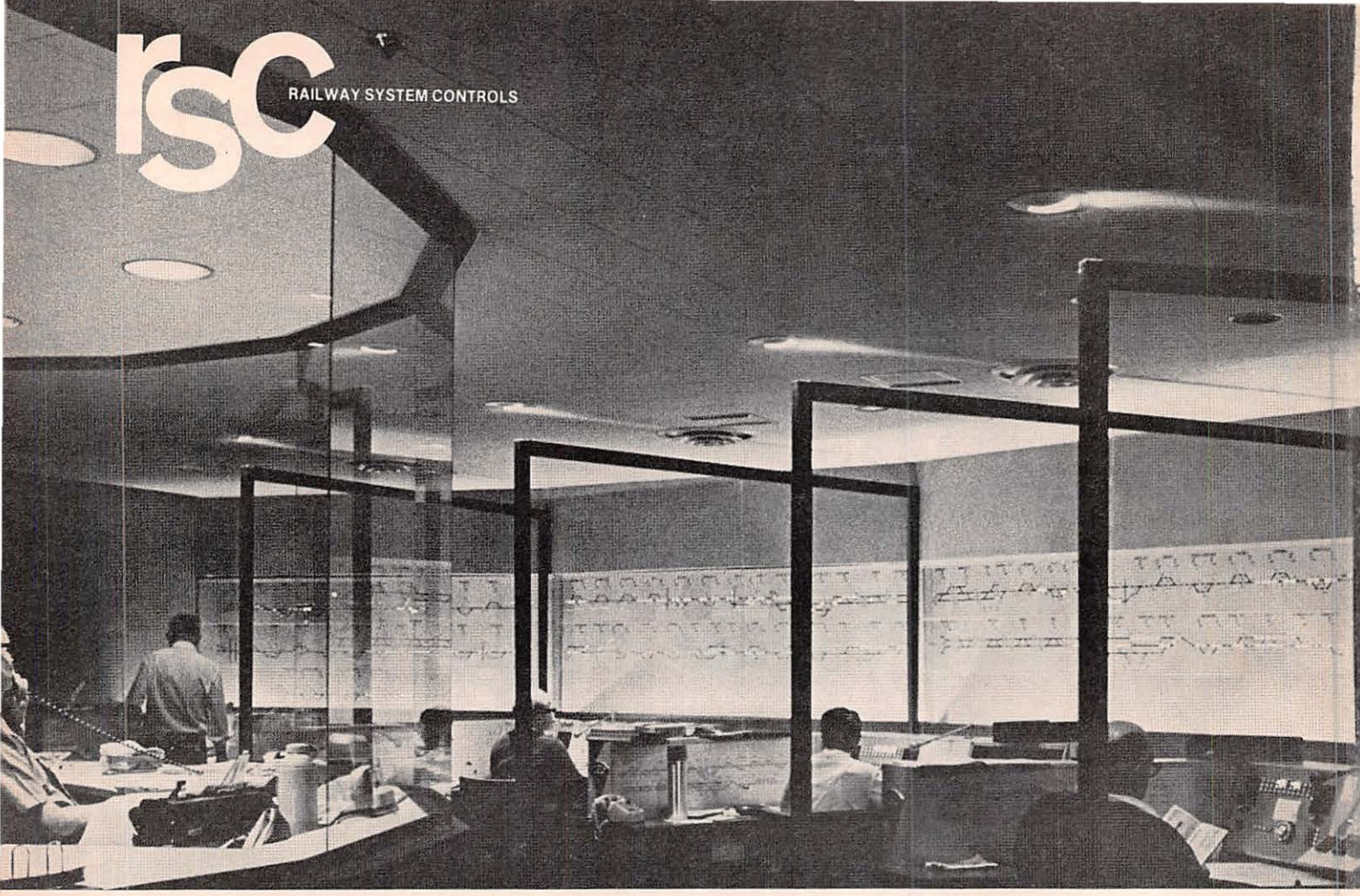
Circle 104 on reader service card

Tech Tips 2-4, the latest in the Westinghouse high-power semiconductor series, tells how to eliminate 120-cycle line noise and RFI in power-controller circuits that use inexpensive bimetallic switches. Although these economic thermostats have a low initial cost, they often lead to varying RFI and circuit noise that can cause malfunctions in data processing or electronic equipment. The article provides a diagram and corresponding waveforms for a typical circuit that suppresses this random noise using off-the-shelf items. *Westinghouse Electric Corp.*

Circle 105 on reader service card

Everything in mobile communications equipment is the focus of the new 16-page, full-line brochure titled "Vehicular Communications." The full-color brochure, from Motorola covers the latest Motorola offerings in mobile communications, car telephones and data communications equipment. *Motorola Communications and Electronics, Inc.*

Circle 106 on reader service card



Dispatchers, in one room, are positioned side by side along the arc of a circle and are separated by glass partitions. The

Mopac gives a new face to CTC

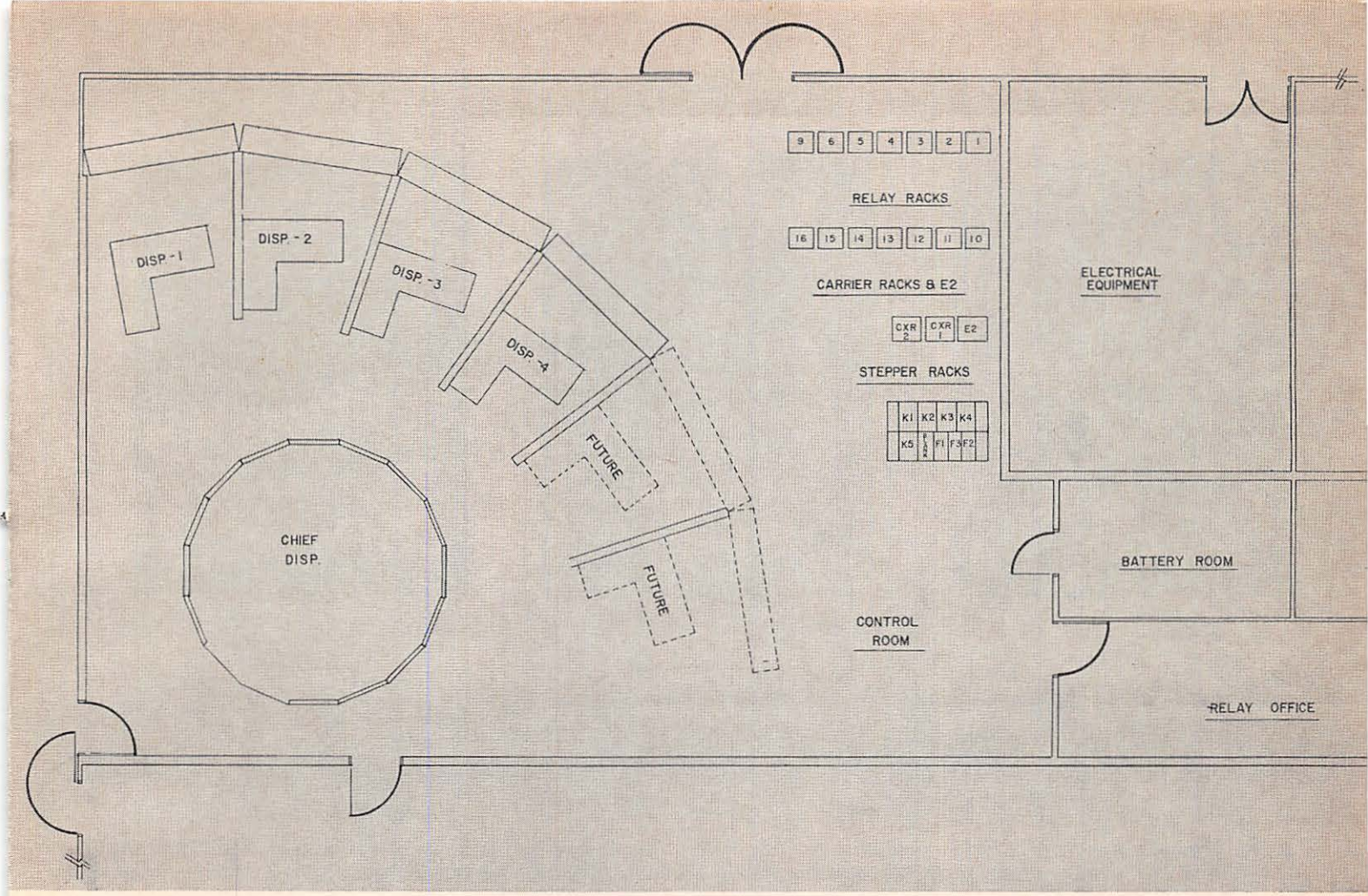
In February 1974 the Missouri Pacific completed installation of its first modern district dispatching center at its new Eastern District headquarters building at Little Rock, Ark. Since 1957 the road has been working toward consolidating train dispatching at each of its district headquarters, and many such consolidations had already been accomplished by relocating existing control machines from the division offices where most had been placed.

Dispatchers from Gurdon and Newport, Ark., and Monroe, La., had been relocated several years earlier to Union Station in Little Rock. As planning to relocate the dispatcher at Popular Bluff, Mo., to Little Rock began, a decision was made to build a new general office building there and vacate Union Station. The decision was made at that time to provide new, more efficient control consoles and a theater-style display arrangement for the entire district, and to incorporate the dispatchers, control machines from Union Station as well as Poplar Bluff into the new arrangement. Space is provided to add the remaining territory on the district at some future time. The territory from Barracks Jct., just south of St. Louis to Texarkana, Tex. and Alexandria, La., a total of 817 mainline miles of railroad is controlled from this office. Previously, three dispatchers were located in the Union Station in Little Rock, Ark. and a fourth in a depot at Poplar Bluff, Mo., controlled the territory.

The new dispatcher's office is equipped with wall-to-wall carpeting and modern push-button CTC machines to replace the old lever types which are standard on most railroads. The dispatchers are in one room, positioned side by side along the arc of a circle and separated by glass partitions. The chief dispatcher occupies a glass enclosure at the center of this arc so that he has a full view of all dispatchers and their display panels. Six dispatcher positions are available; four of these are complete, with two remaining for future installations.

Each segment of railroad included in this consolidation was previously controlled by any one of a number of types of CTC code equipment, i.e., Type K, F or E2 manufactured by GRS. All of the basic coding equipment in each of these present installations was re-used and simply moved to the new central point. No changes were required at any of the existing field locations. However, two carrier converter locations were added and existing carrier converters were updated. All other parts of the existing CTC machines, other than the basic coding equipment, were retired. The result is a new face for an old reliable and trusted CTC system. This new face is the product of Harmon Electronics, Inc. of Grain Valley, Mo.

The new control machines consist of modern control consoles added to a standard desk, replacing the panels equipped with levers and lights which previously surrounded the dispatcher. The console is designed for maximum operator convenience and efficiency, with all controls at his finger tips. The display has been separated from the console itself and wall mounted and the size increased for easy viewing.



chief dispatcher occupies a glass enclosure at the center, with a view of all dispatchers and display panels.

The control console contains a keyboard that replaces the multitude of levers and buttons which were used on the old style machines. Two digital displays are provided to read our numerical information as it is fed into the console. In the event of a problem, a spare keyboard with plug connector can be put in service in a matter of minutes. Each dispatcher has an identical keyboard.

The keyboard is divided into three groups of buttons. The first is used to select any numbers that are involved with sending a control, such as location numbers and switch and signal numbers. The second group contains the switch and signal function. A third group is provided for any miscellaneous function desired.

A track blocking panel is provided at the dispatcher's left hand to block sections of track and switches, and to provide a reminder function for trains occupying a siding.

The display panel provides the dispatcher with all necessary information on train position and the status of switches and signals. The display is made of anodized aluminum panels, fitted into a steel frame.

Track plan and lettering is etched in black and is large enough to be read from adjacent positions and from the chief dispatcher's desk. Indication lights are fitted flush with the face of the panel and are inconspicuous until illuminated. Lamp replacement is made through doors at the rear of the display cabinet.

Panels may be moved or replaced in event of a track plan change. This is made easy by having each control point on a single section of panel, which is plug-connected to the machine. These panels are firmly held in place by spring clips.

Between the relocated office master code units and the new consoles and display panels there is an extensive amount of storage and switching circuitry employing Harmon's unique NOVILOG (NOn-VItal LOGic) concept of modular circuitry, which utilizes high-grade, low-cost miniature relays mounted on printed circuit boards for all switching. The circuits on each type of board are designed around a specific function, such as controls and indications for one switch or one signal. Since most of the repetitive type of circuit is printed on the boards, the amount of hand-wiring required is greatly reduced. Virtually all of the circuits required are available on 15 standard plug-in modules. The total number of modules required for the complete installation is approximately 1700. Each module is equipped with a row of test points, allowing a maintainer to check on the operation at key points in the circuits. Boards may be readily removed and replaced when maintenance is needed, and the arrangement of circuits is such that a problem can generally be isolated to a particular plug-in module very quickly. Modules will plug into individual sockets and rack-mounted cabinets. Interconnection wiring between modules is done directly on the backs of the racks. Wiring from one rack to another, or from the racks to the control room, is made through plug connectors on each rack, allowing for ease of handling and, if necessary, replacement.

Floor trenches provide the path for all interconnecting cable.

Console operation

The following example outlines the manipulations required for two trains to meet.

Arkadelphia siding has been selected by the dispatcher to meet Train #1 (Northbound) and Train #2 (Southbound). Train #2 will take the siding for #1 to hold the main.

Number 148 is selected on the key-

1	2	3
4	5	6
7	8	9
RESET	0	

LOC	NOR	NORTH
LOC CAN	REV	SOUTH
CODE CAN	RE-CHK	STOP
	START	

MC ON	SM ON	GATE OPEN
MC OFF	SM OFF	GATE CLOSED
BELL LINE ON	CARR 1	ANN
BELL LINE OFF	CARR 2	ANN CAN

CTC PUSHBUTTON ARRANGEMENT

The dispatcher control console contains a keyboard which is divided into three groups of buttons. The first is used to select any numbers that are involved with sending a control. The second group contains the switch and signal function. A third group is provided for any miscellaneous function desired.

board and appears in the left hand digital display. The LOC button is depressed to "call-up" location 148. The LOC button will transfer 148 to the right hand display window, illuminate a white light under 148 on the display panel, and direct the forthcoming controls to that location. The route through the switch is illuminated white at this time. In the event that the wrong location has been selected, LOC CAN (Location Cancel) will erase the wrong location. The correct location can then be selected. Check circuits limit the dispatcher to only those locations under his control. (Only one location may be selected at a time.)

After the location is selected, the dispatcher can proceed with the switch and signal calls, or any other miscellaneous function (in any order). Train #2 will take the siding so REV is depressed for a reverse switch. SOUTH is depressed to clear a southbound signal into the siding.

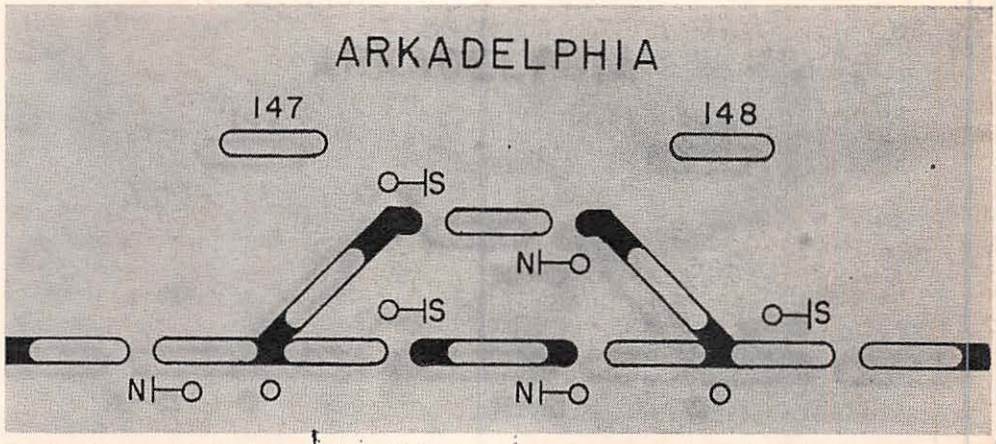
White flashing lights show the route called over the switch, and the southbound signal will flash green. Flashing indications show that the office is not in correspondence with the field. The route display also allows the dispatcher to check his move before the information is transmitted to the field.

Until the START button is depressed, the code will not be sent to the field. Therefore, any change in the line-up can be made prior to depressing the START button. To change a switch line-up, only the proper call need be made to change the position. For a change in signal call, STOP must be used before the new call can be made. If opposing signals were inadvertently called, a signal-at-stop code would be sent to the field.

When the START button is depressed for location 148, the white light under 148 will go dark and the code will be on its way to the field. The dispatcher is now free to select another location.

When the code is received, the field will answer with the proper indications. The light under 148 will now be illuminated red to show that station is indicating. The flashing lights will go to steady when the indication is received that the switch is reverse and the signal is clear.

Before, during, or after the indications return for station 148, location 147 may be selected and the line-up



Track plan and lettering on the dispatcher's display panel is etched in black and is large enough to be read from adjacent positions and from the chief dispatcher's desk.

made for Train #1. Select number 147, LOC, NORTH for a northbound signal down the main, and START. The indication cycle for this station will progress in the same manner as 148.

Track occupied indications illuminate the track plan in red. When Train #2 passes the southbound signal, the OS section will be illuminated red and the signal indication will go dark. After a train passes over a section of track, the track plan will go dark. One exception is that when a switch is reversed, a single white light will remain on to indicate the switch is left reverse. When the train passes over a normal switch, the route is left dark.

As a reminder for the dispatcher, a jack can be inserted into the passing track on the jack panel. This illuminates the passing track red to indicate that siding is occupied.

Once #2 is off the main, route for #1 can be set up by selecting 148, LOC (Location), NOR (for switch normal), NORTH (northbound signal), and START.

When #1 is clear of 147, #2 can be cleared out of the siding 147, LOC (Location), REV (switch reverse), SOUTH (southbound out of pass) and START.

Illegal routes will not be accepted in the machine. For example, if an attempt were made to line two opposing trains into the siding, only the first legal line-up would be accepted; the second would be rejected.

The jack panel also provides a track block. If a jack is inserted into a section of track, signal control circuits are opened so that no signal can be cleared over that section of track. This is indicated on the display panel by amber track lights.

A switch blocking jack is provided to block a switch in its present position, whether normal or reverse. This is indicated on the display panel by an illuminated amber dot near the switch.

Other functions on the keyboard include CODE CAN (Code Cancel). Operation of code cancel button will cancel any starts which have been stored in the machine.

RE-CHK (Recheck) is to recheck indications from a field station. To operate, select a station number, LOC, RE-CHK, and START. A buzzer will indicate when recheck cycle has been sent.

Other miscellaneous functions

MC—Maintainer Call
SM—Snow Melter
GATE—For control of electrically locked gates.
CARR—Carrier transfer function.
BELL LN—Telephone circuits operation
ANN—Annunciation
These functions are initiated only at the selected location.

Mixture of physical, carrier, and leased facilities provide link to Little Rock

Moving the CTC machines to Little Rock required a great deal of thought with regard to the method of getting the control and indication codes to and from the new dispatcher's headquarters and distant control sections.

Two systems are operated by a physical circuit. These are the lines north and south of Little Rock. North of Little Rock is a Type K (two-wire) physical line and south of Little Rock is a Type F (three-wire) physical line. The two-wire Type K physical line north out of Little Rock could have been used to transmit the carrier signals for the Type F system between Newport and Harviell Jct., but it was decided that all carrier circuits from Little Rock should be treated alike.

The Type E2 system from Little Rock to Alexandria was already a carrier controlled system superimposed on the dispatcher's circuit so this system was not changed. The other systems now utilize Telpak circuits and decription of the circuits follows.

1. Bell Telpack circuit, North Little Rock to Poplar Bluff

This is a multi point 4-wire circuit that operates CTC converters at the following points:

a) Bismark. Type K—Control points are South Mineral Point including Barrack Jct. RFL 3F Carrier, 935 Hz—Transmit and 935 Hz—Receive.

Telephone for voice communication is via a network phone and CTC code line.

b) Poplar Bluff. Type K—Control points are Black River Jct. including north switch at Bismarck. RFL 3F Carrier, 2635 Hz Transmit and 2635 Hz—Receive.

Voice communication is via a network phone and CTC code line.

There is also a carrier interface operating on a Telpak circuit. Interface equipment is housed in the same cabin and operates control points Harviell to Poplar Bluff, Arkansas Division and Junland, including Cahrleston Jct. on the Illinois Division.

RFL 3F Carrier, 1615 Hz Transmit and 1615 Hz receive.

Interface carrier is Harmon 530 frequency 6.2 KHz Control 5.4 KHz. Indication bridged on with a high impedance bridge circuit.

Voice communication is via a network phone and CTC Code Line.

c) Newport Type F—Control points are Diaz to Harviell Converter Cabin. Harviell Converter cabin is used only for transfer of Carrier equipment (RFL Carrier).

RFL 3F Carrier frequency, 1275 Hz Transmit and Receive.

In case of failure in the Bell circuit loop or RFL Carrier, North Little Rock to Newport: the F converter will automatically transfer to Harmon Equipment 6.2 KHz controls and 5.6 KHz indications. Harmon carrier is on K code line, North Little Rock to Newport. When an automatic transfer occurs, it will operate on K code line and Harmon carrier until manually reset by dispatcher or by the signal maintainer at Newport Converter cabin. The carrier is turned off when not in use.

Voice communication is via a CTC code line.

2. Bell Telpak Circuit, North Little Rock to Gurdon

This is a 4-wire circuit used for primary control of the Type "F" converter cabin at Gurdon, Arkansas. Carrier is Lenkurt 25B, 1190 Hz control and 850 Hz indications. Control points—Gurdon to Texarkana.

In case of failure of the Bell Circuit loop or Lenkurt carrier: transfer to dispatcher phone line with Harmon carrier is automatic, and will remain on fall back equipment until reset by the dispatcher or signal maintenance personnel. Harmon frequencies 9.5 KHz control and 8.2 KHz indication. Harmon equipment is turned off when not in operation.

Voice communication is via a network phone.

3. Bald Knob Converter Type K

Harmon carrier 9.5 KHz control and 8.2 indication, superimposed on the Little Rock to Newport CTC code line. It is bridged on at Bald Knob using a a high impedance bridge circuit. Controls Bald Knob Y switch to and including north switch at Crawfordsville.

Voice communication is via a CTC code line.

4. Little Rock to Alexandria Type E2 Carrier Drop System.

Carrier is superimposed on communication wires 30 and 31. Dispatcher wires 32 and 33 are used as back-up wires and cabins and equipment must be manually transferred.

Carrier equipment is 3F-RFL. Control freq. 10 KHz. Indications from field to office 6 KHz with a 1200 KHz band width. Repeaters are located at McGehee and Monroe.

Voice communication is via the dispatcher or message wire.

5. North Little Rock to Newport is Type "K" physical line control.

6. Little Rock to Gurdon is Type F physical line control.

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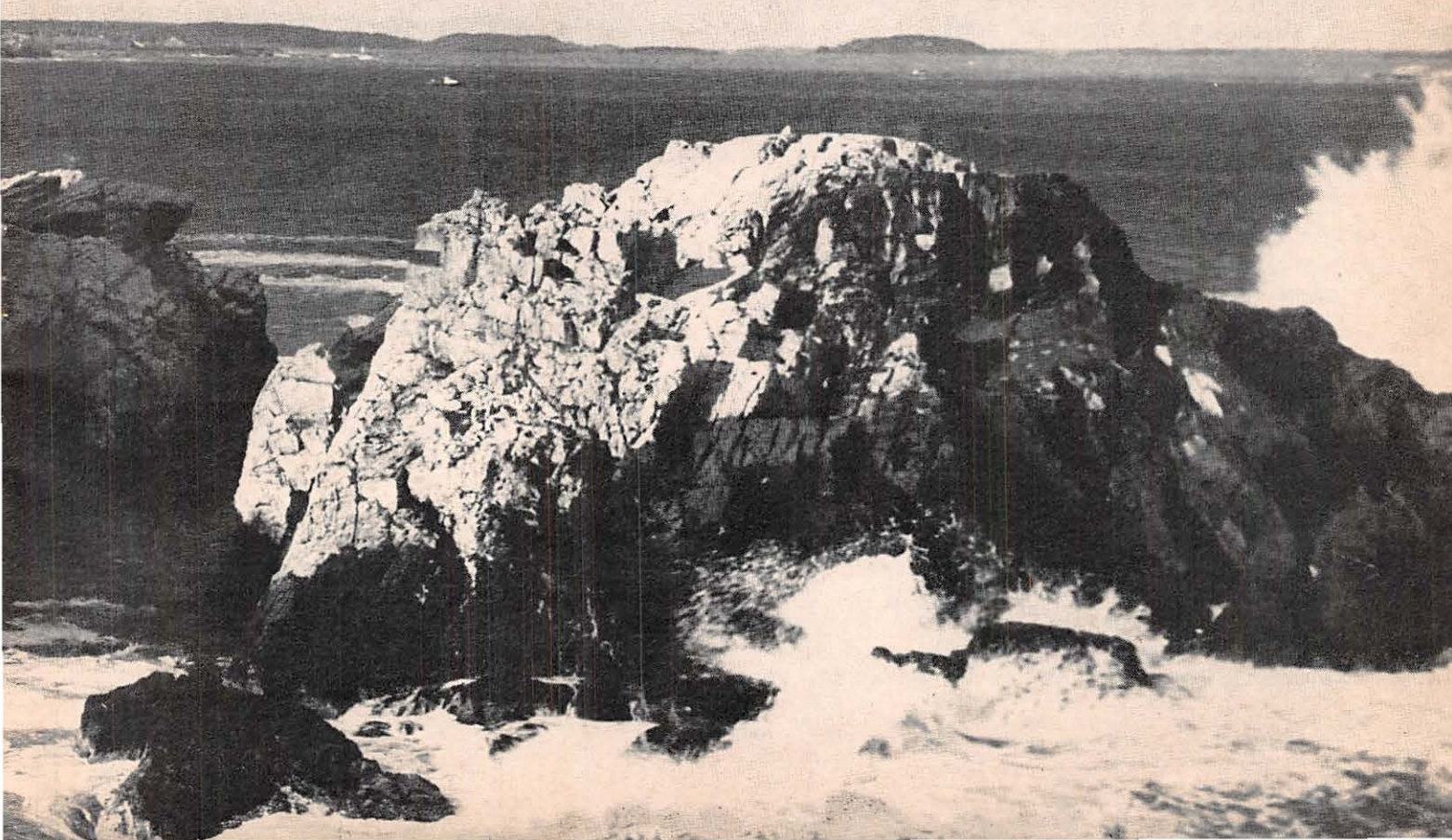

1. Title: DIRECT CURRENT TRACK CIRCUIT.

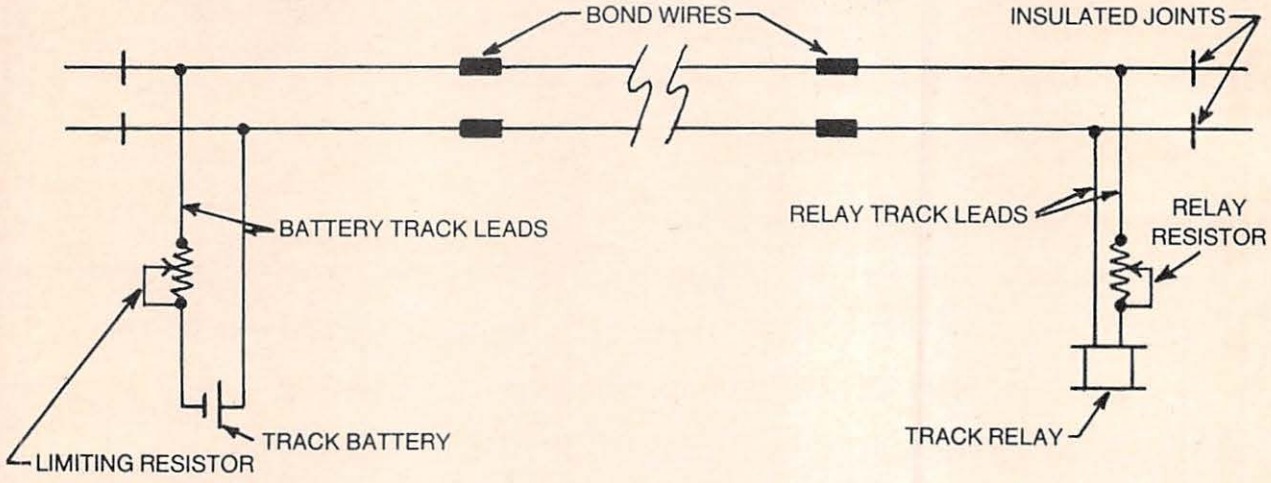

Fig. 1. Typical direct current track circuit.

2. Definition:
An electrical circuit of which the rails of the track form a part.

3. Symbol: None.

4. Description:
As shown in Fig. 1, the circuit consists essentially of a section of track, a battery and adjustable limiting resistor at one end, and a relay and adjustable relay resistor at the other end. The section of track used in the circuit is separated, electrically, from adjacent sections of track by insulated rail joints placed in each rail at each end of the section. The individual rails within the section are bonded together at the intermediate rail joints, by means of bond wires, to form continuous reliable conducting paths.
Note: Fig. 1 shows a variable resistor in the battery and relay leads. Although the relay resistor is most often installed in new installations many roads have track circuits in service with a battery resistor only. Also some roads use a fixed resistor in place of the variable resistor at the battery end.

5. Purpose and Application:
The primary purpose of a track circuit is to detect the presence of a train in the track circuit section. It also provides a means of detecting a broken rail.

The track circuit is a very important link between moving trains and wayside signal equipment. Some important applications of the track circuit appear in block signal systems, highway crossing protections, interlockers, etc.

6. General Information:
Although the track circuit appears to be a simple series electrical circuit, it is in fact quite complex. The rails, which are the main conductors, are mounted on ties, placed on ballast, and as ties are not perfect insulators, the resistance to ground is subject to considerable variation. This provides an infinite number of paths for current leakage between the rails through the ballast. When the ballast is wet, dirty or contains a high metallic content, this leakage may increase to a point where the relay current will be reduced to the extent that the relay will drop without train occupancy. Conversely, under very dry or frozen conditions, this interrail leakage will be at a minimum permitting maximum current to flow in the relay coils. If the electrical circuit is improperly adusted—erratic relay operation will result. That is, enough current would continue to flow through the relay coils which are in parallel with the shunt provided by the trains wheels and axles. It is therefore extremely important the circuit be properly adjusted.

The variable limiting resistor at the battery end and the variable relay resistor at the relay end provide the facility to properly adjust the track circuit. Each railroad has instructions on the proper method and values for track circuit adjustment and it is important that every employee be familiar with these instructions.

In addition to the circuit adjustment, it is important that every signalman recognize the importance of regular inspection of the circuit components. Because the bonds, joints and track leads are susceptible to damage and wear from dragging equipment, work equipment and normal train travel, it is very important that these components be maintained in good order. Frequency of inspections also differs between railroads and signalmen should know the requirements of their company.

7. Detailed Operation:
As mentioned earlier, the primary function of the track circuit is to detect the presence of a train in a track section. Figs. 2 and 3 illustrate a simple example of track circuit operation in which a signal at one end of a track circuit governs train movements into that section.

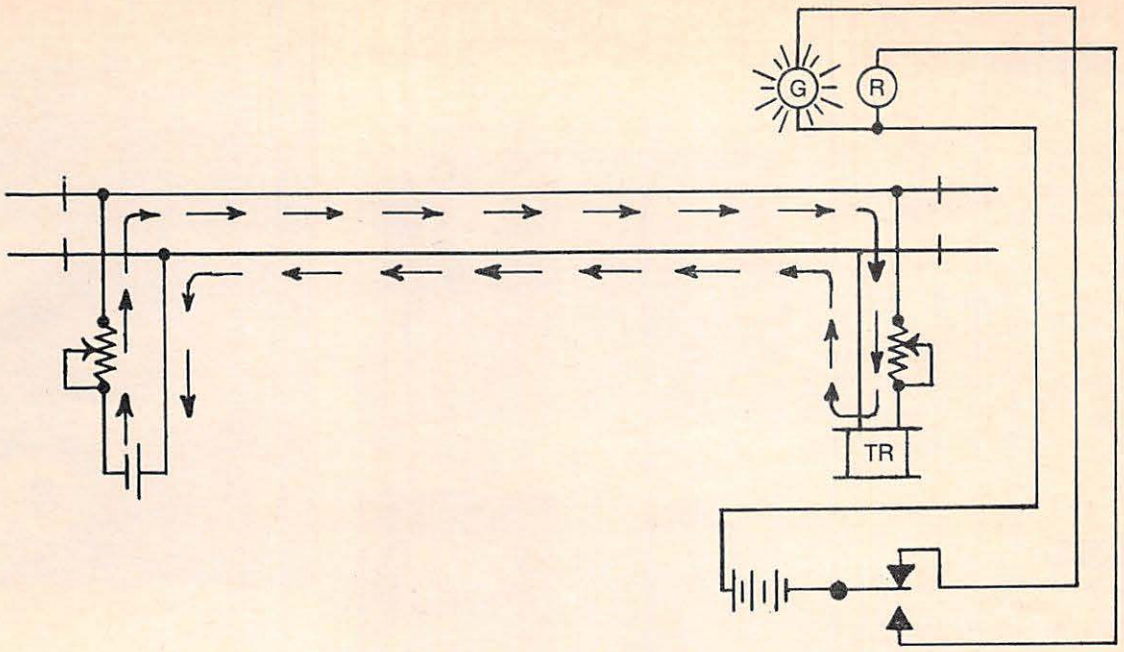

Fig. 2

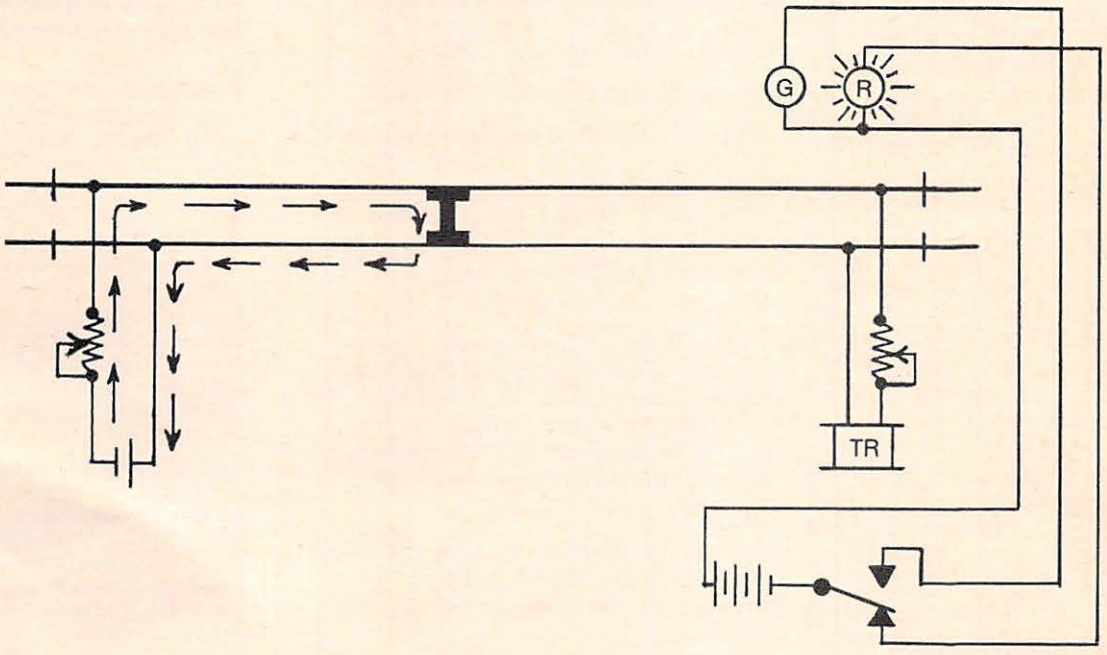

Fig. 3

Fig. 2 illustrates normal track circuit conditions. That is, there is no train in the circuit, therefore current from the track battery has a complete path through the rails and track relay coil as shown by the arrows. The presence of current in the relay coil produces the necessary electro-magnetism to pick up the relay armature which closes the front contact of the track relay.

With the armature up, a secondary circuit, fed from an operating battery, is established through the TR front contact and a lamp behind the green lens of the signal. The green aspect of the signal would indicate to an approaching train that it is safe to proceed.

Fig. 3 illustrates the effect of a train occupying the track circuit. Note that the arrows now indicate that the current flow is through the rails and the train wheels and axle. The current through the relay coil has been shunted out by the train. The relay coil loses its electro-magnetism and the armature drops, which closes the back contact. This opens the secondary circuit to the green signal and closes a current path to the lamp behind the red lens to indicate stop to a following train.

Should a rail within the track circuit be broken, the signal will display a red aspect because once again current will not flow in the relay coil and the secondary circuit will be made through the back contact.

People

PENN CENTRAL.—J. J. **Gillies** appointed assistant engineer-communications, Metropolitan Region, New York.

SANTA FE.—**B. J. Hutton,** assistant superintendent of signals-system, Chicago, appointed superintendent of signals-system. **Robert W. Convey,** project engineer, Chicago, appointed assistant to superintendent of signals-system.

B. J. Hutton
Santa Fe

Robert W. Convey
Santa Fe

SUPPLIERS

Loren L. Raglin, manufacturing manager, **Granger Associates,** has been elected vice president of the company.

Loren L. Raglin
Granger Associates

Edwin G. Vineall
GRS

Edwin G. Vineall has been appointed manager of application engineering, **General Railway Signal Co.,** Rochester, N.Y. He has been serving as program field test manager, Washington, D.C. Metro automatic rapid transit project, where he directed GRS and subcontractors' personnel in the testing and placing in service of this complex system.

Thomas P. Marple has been appointed sales engineer—railroads and rapid transit systems, **Okonite Co.,** Ramsey, N.J. He will continue to report to Robert B. Zane, vice president-railroad and rapid transit system sales.

Philip W. Bolster has joined the Cornish Wire Products Division, **General Cable Corp.,** as division manager of industrial relations, Williamstown, Mass.

William T. Warburton, director of financial planning, has been named general manager, Bare Wire Operation.

Stephen L. Breckley has been named manager of facilities planning, Greenwich, Conn.

John J. Weber has been named distribution center manager.

Bradley S. Stump has been appointed midwest regional sales manager, **Continental Wire & Cable Corp.,** a subsidiary of the Anaconda Co.'s Wire and Cable Division.

George W. Sullivan has been appointed vice president and general manager, Transmission and Switching Systems Division, **Collins Radio Group, Rockwell International Corp., Dallas, Tex.** Mr. Sullivan was formerly vice president and general manager, Telecommunications Equipment Division.

George J. Mitchell has been appointed manager, mobile communications product management, a new position in the **RCA Mobile Communications Systems** organizations at Meadow Lands, Pa. Mr. Mitchell had been manager, product administration.

John Myers has been named Western Regional sales manager, **ITT Switching Center,** Des Plaines, Ill., and Milan, Tenn. Mr. Myers was formerly Western Area sales manager, ITT Electronmechanical Switching Department, Milan, Tenn.

Roger C. Agnelly, sales representative-Milwaukee district, **Okonite Co.,** has been appointed manager-Pittsburgh district.

Lucius W. Carney, senior salesman, Wire & Cable Division, **Anaconda Co.,** Atlanta, Ga., has been appointed Kansas City district sales manager for power cable, succeeding **Gerald Fugate,** who has been named product manager for portable power cables at the division's Marion, Ind., plant.

John M. Macko, standards engineer, Wire & Cable Division's Hastings-on-Hudson, N.Y., plant, has become a salesman, New York district office.

Roger S. Bessette has been appointed president, **Transcom Electronics Manufacturing Ltd.,** St. Jerome, Que., Canada, a wholly-owned subsidiary of **Lynch Communication Systems, Inc.** Mr. Bessette was formerly vice president and general manager.

Which

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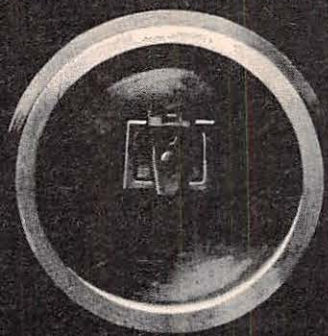

Servo's new Universal Alarm System with automatic bearing identification*

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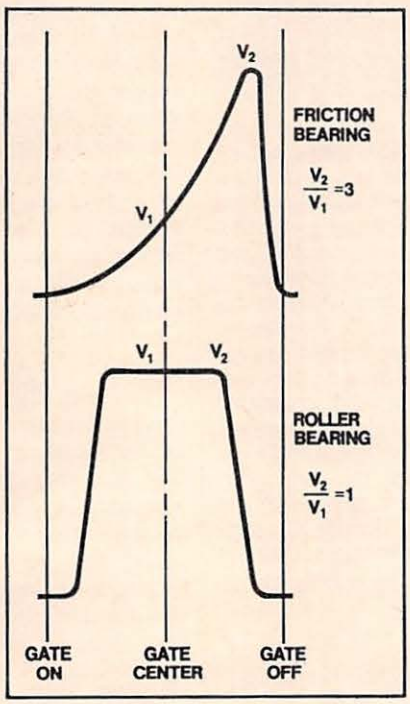

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Electrical noise: Get it out of the

N. C. JACKSON PACE
Assistant Vice President
Communications & Signal Department
Southern

For the past several years, the use of delicate, sensitive and sophisticated interference-susceptible electronic apparatus in communications and railroad signal applications has, *with some measured success*, experienced accelerated growth. *This is especially true in railroad signal applications.* I can, as can many others engaged in signal plant operations, substantiate the statement *"with some measured success."* Most of us have had some trying experiences in placing into operation and maintaining the proper operation of such apparatus as mentioned above.

Communications people have long recognized many problems in their plants that now prevail in signal plant operation. This recognition comes from having to cope with the inherently low power level character of circuitry used in communications (low powers and voltages encountered in telephone and radio circuits).

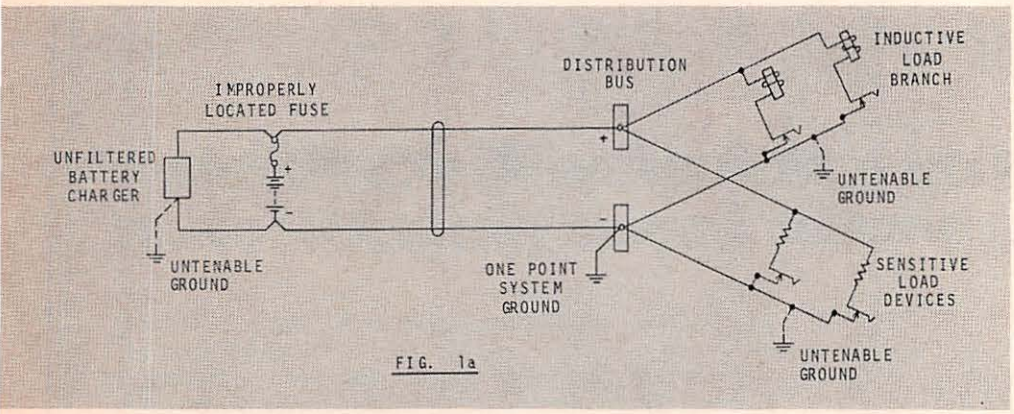

FIG. 1a

Fig. 1a **Exemplifies an incorrect plant design.** The long high resistance common feeder leads between the battery and the distribution bus effectively removes the low impedance battery (electrically) to a point remote from the distribution bus thus causing the battery to become ineffective as a low impedance shunt to spikes and noise generated in the system, i.e. unsuppressed interference generated by collapsing magnetic fields in the switched inductive load branches of the system etc. This interference appears across the distribution bus and is therefore prevalent in all branches of the system, causing harmful interference to the proper functioning of the susceptible sensitive load devices. The improperly located fuse, of course, adds detrimentally to the impedance of the long high resistance common feeder leads. Also, the improperly located fuse being connected in common path with the charging and load currents causes harmful ripple noise from the unfiltered battery charger, appearing across the fuse, to be injected in series with the common feeder system and thus into all branches of the system. Sometimes inadvertent **untenable grounds** as shown are cause for serious interference problems. Differences in potential existing between the **one point system ground** and other grounds in the system cause harmful interfering currents to flow in wire connections between the grounds, see Fig. 1b for clarification.

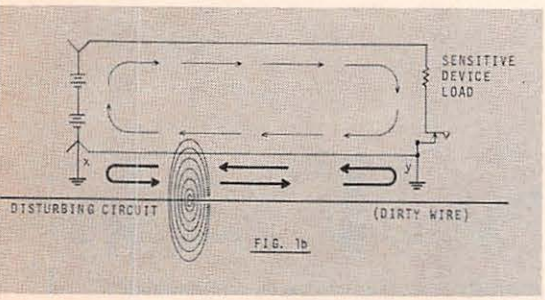

FIG. 1b

Assume that the segment of interfering circuit shown contains voltage spikes or other noise currents (in other words, a dirty wire). The EMF in this dirty wire is inductively coupled, as shown, to the nearby wire existing between the system ground at point x and the unwanted ground at point y. This causes the induced interfering currents to flow in the loop consisting of the wire between points x and y and the earth itself, see heavy arrows. The harmful interfering EMF thus developed in the wire between point x and y are injected in series with the entire branch circuit, see light arrows, appearing, of course, across the sensitive-device load to cause possible erroneous operation of apparatus in that branch of the system.

Fortunately, communications people have been able to design their plant and devise pratices to alleviate those problems that are precisely similar to many of the problems that we are now experiencing in the signal plant. Sometimes problems that give us such a hard time are seemingly unidentifiable, such problems as fortuitous false operation of computer controlled devices, erroneous indications, spurious unaccounted for happenings, and many subtle things of this nature.

The prime enemy of communication is noise." In discussions such as this, we mean electrical noise; however, the effects of electrical noise are analogous to physical noise effects: For instance, have you ever tried to carry on a conversation with someone in a heavy noise environment, say in a car shop where several air hammers are operating? The impact or impulse noise can mangle the information flow being attempted to the point of unintelligibility.

Noise in signal circuits (electrical noise caused by unfiltered rectifier ripple, high voltage spikes or transients caused by unsuppressed surges generated by collapsing magnetic fields in relays, etc.) can in similar fashion mangle low level data/control commands entering and progressing through a control computer complex or CTC system so as to cause erroneous response, improper operation of switches, retarders, wrong accounting advice, faulty inventory control, false indications and other malfunctions. Such noise can cause many seemingly unexplainable anomalies.

Undoubtedly, the worst (greatest) contributor to electrical noise in both communications and signal systems exists in improperly designed power sources, i.e., battery chargers, batteries themselves, unnecessary long common paths in power wiring, improper grounding practices, wrong fuse or circuit breaker placement, wires not large enough and other such wrong practices. See Fig. 1a.

On the other hand, a properly designed and properly implemented power plant provides unmitigated aid in suppressing noise that is inherently generated in a complex electrical/electronic system. See Fig. 2.

Some of the requisites for a properly designed power plant, such as is herein under discussion, are as follows:

1. A well filtered battery charger. Diode chargers (especially SCR Controlled chargers) produce ripple voltages that are sometimes rich in harmonics that extend high enough in frequen-

RAILWAY SYSTEM CONTROLS

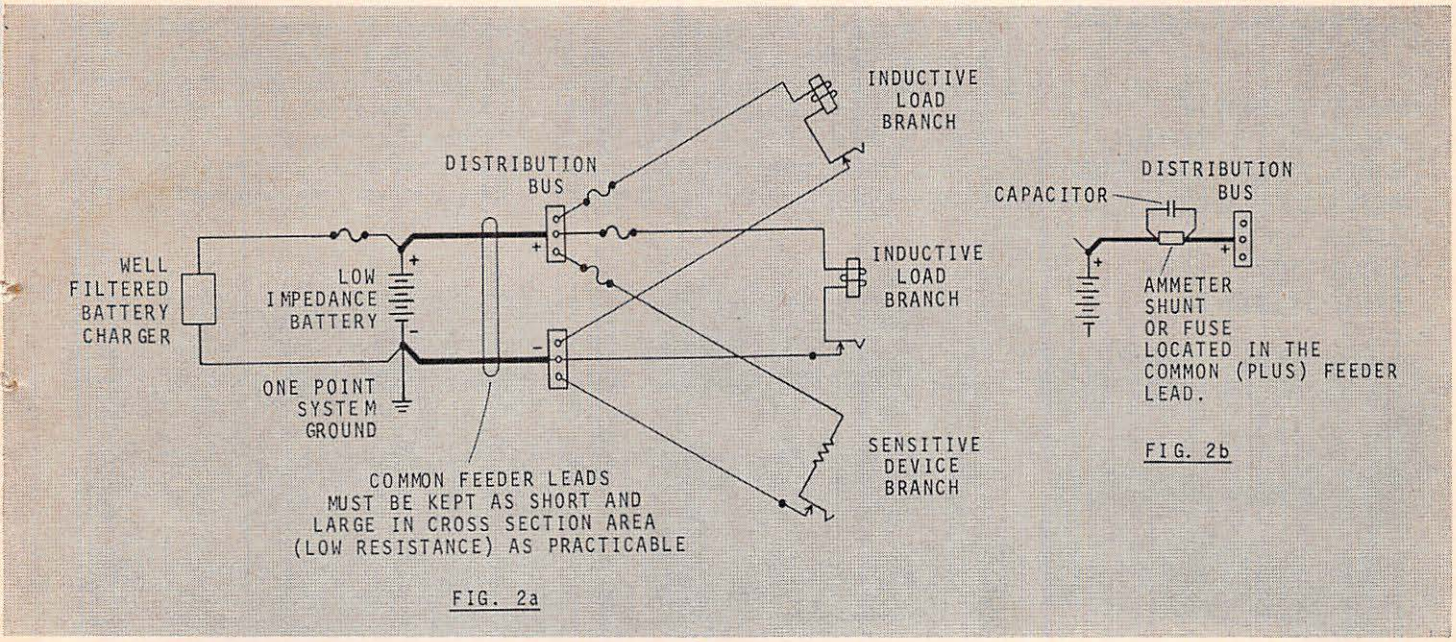
INDUCTIVE LOAD BRANCH
DISTRIBUTION BUS
WELL FILTERED BATTERY CHARGER
LOW IMPEDANCE BATTERY
INDUCTIVE LOAD BRANCH
ONE POINT SYSTEM GROUND
SENSITIVE DEVICE BRANCH
COMMON FEEDER LEADS MUST BE KEPT AS SHORT AND LARGE IN CROSS SECTION AREA (LOW RESISTANCE) AS PRACTICABLE

FIG. 2a

FIG. 2b

Fig. 2a represents a correctly designed power system. The low impedance battery is located electrically near the distribution bus where power is connected to branches feeding individual load devices. Ideally each load device would be connected to the distribution bus by an individual separately-fused branch circuit. This may not be practical in many cases. However, **in no event must sensitive devices and inductive load devices share the same branch.**

If the distribution bus is located physically near the battery, as it should be, the need for a fuse in the common (plus) feeder lead will not exist. This assumes that all separate branches are fused as shown. In some cases, the placement of an ammeter in the common (plus) feeder lead may be required. Since the ammeter and its shunt will be connected (detrimentally, considering noise and spike suppression) in series with the common feeder conductor, the meter element should be extremely sensitive in order to allow the shunt element to exhibit the lowest possible resistance.

If the use of either or both the common fuse and/or ammeter is essential, their ill effects can be somewhat reduced by shunting the fuse mounting or/and the meter shunt with a **non-inductive low resistance** capacitor of proper value (value depending on circuit parameters, the magnitude of noise/spikes, amount of current in the circuit, etc.), See 2b. Since any resistance element added in series with the common feeder leads reduces the ability of the battery to absorb noise/spikes, it is obvious that metering and fusing should not be implemented unless absolutely essential.

cy range and magnitude to cause interference to the operation of audio overlay and other frequency and/or voltage level sensitive devices. Ripple voltages should not exceed 100 millivolts or better yet 30 millivolts.

2. Perhaps of equal importance is the use of a low impedance battery bank, located as close (electrically) as practicable to the apparatus to be powered. This statement contemplates the internal cell resistance and the resistance of the connecting straps between cells. All common path wiring and the connections themselves must be made to exhibit near zero resistance. See Fig. 4 for test methods. The internal resistance of a battery cell decreases as the size (capacity) of the cell increases. This characteristic warrants consideration in the choice of battery size in plant design. The low impedance battery bank (meaning extremely low impedance) can and does in a *properly wired* plant configuration offer virtually a short circuit to noise, high voltage spikes/transients which may be inherent in the system. In a properly designed plant, noise and spikes generated in any branch of the power system are absorbed by the low impedance battery, thus preventing their appearance in all other branches of the system.

It has probably been assumed that a nickel cadmium battery of a given capacity offers a lower internal resistance than does a lead acid battery of the same size. Theoretically this may be true considering the resistance of the electrolyte between plates, but several factors must be considered in determining the true internal resistance of the cell, remembering that, in this discussion, we are concerned with the battery's voltage stability and its ability to short-circuit unwanted noise/spikes and not necessarily its ability to sustain large high level current flow for short periods of time. The cell should exhibit low impedance and stable voltage at all current levels.

The internal structure of the cell is pertinent to its internal resistance, whether each plate assembly and its external connecting post are cast together in one solid mass (electrically) as in most lead acid cells or whether the elements and external connecting posts are merely bolted together under compression as is seen in some nickel cadmium cells. I know of at least one type nickel cadmium cell that does exhibit measurable internal resistance which can only be attributed to resistance in electrical connections in the internal structure. This condition is probably caused by the elements being clamped together with insufficient compression or perhaps poor quality control in manufacture. Some connecting straps (cell to cell) furnished with the battery, although seemingly of proper size, actually exhibit measurable resistance. Other connecting straps made in the field from short pieces of too-small wire and improper crimp-on unsoldered lugs have been observed to cause almost unbelievable high resistance and high levels of noise. See Fig. 4 Test Methods. It must be realized that such high-resistance-produced noise appears as a

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separate but harmful series added noise source in the total system. The existence of this noise also provides evidence that the total battery bank is not presenting the ultimate in low impedance image at his end terminals.

3. Proper length and properly sized conductors in the wiring scheme is essential. Ideally, wire sizes would be determined not only by the actual load current requirements; the short circuit (distant end) current carrying ability of the conductors should also be a factor in making this determination.

Fast rising, steep wave front voltage spikes can realistically be assumed to be comparable to one-half cycle of a high frequency sine wave, possibly in the order of 1 mHz. Therefore, if we are seriously considering the power plant's ability to aid in the suppression of such spikes, wire size and length in all common path circuit segments becomes an extremely important factor

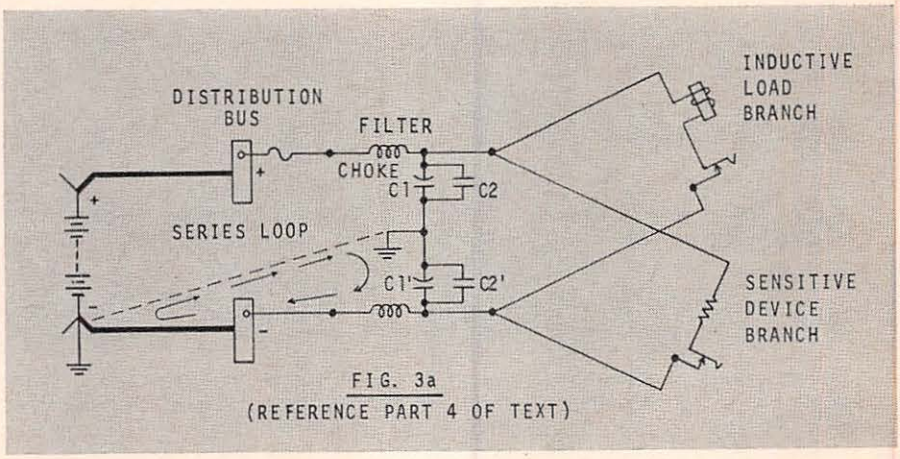

FIG. 3a
(REFERENCE PART 4 OF TEXT)

Fig. 3a Represents a circuit configuration which makes improper use of a filter. (See Part 4 of the text.) In the first place the filter is of improper design in that the center point between the capacitor elements is grounded when one side of the power system (negative) is already grounded. This creates a series loop path for interfering currents and also effectively shunts or disturbs the character of the negative side of the filter. Actually even if the filter shown was of a proper design with no midpoint ground, its use in the circuit configuration shown would be more harmful than beneficial, in that the series impedance elements of the filter (chokes) effectively limits the low impedance battery's ability to absorb harmful noise/spikes generated in the inductive load branch, noise/spikes which must, in this configuration, appear across the sensitive-device load branch which shares the same filter. The purpose of the **one point only** system ground is to stabilize stray capacitance developed voltages which may appear in the system. In some instances **non inductive low impedance** decoupling capacitors (usually low capacity with actual value dependent on other circuit parameters) may be applied **directly across each** load device in all branches of the system to offer improvement in interference reduction.

In filter design, caution should be exercised in the choice of circuit elements or the filter may not provide expected results. It should be realized that most large high MF capacitors also exhibit series inductance. (Unless of special design.) The purpose of C_2 in parallel with C_1 in the filter configuration shown is to allow the low inductance small

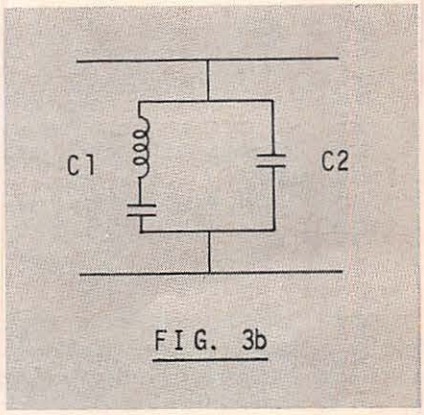

FIG. 3b

capacitor C_2 to provide a non inductive path for high frequency currents that are not affected by the large inductive capacitor C_1, in other words an attempt to nullify the effect of C_1's inductive component. The resultant circuit element may look like the network shown in Fig. 3b which would obviously be anti-resonant at some frequency, depending on component values. At this particular anti-resonant frequency, the capacitive elements in the developed filter will be transparent and ineffective.

In any event if filters are to be used as a means to suppress noise/spikes, a separate filter must be provided for **each individual** load device in a circuit branch. One filter for each circuit branch containing various load devices will not suffice to offer reduction of interference imposed on the various load devices. The best of filter design, if used in the latter fashion, will be more harmful than beneficial.

because at 1 mHz., a No. "0" gauge wire looks like a No. 19 gauge wire at dc. This phenomenon is obviously due to skin effect and straight wire inductance which is always more prevalent at higher frequencies; nevertheless this phenomenon dictates that minimum length runs and oversizing of all common path wiring be implemented to allow a low impedance battery to effectively reduce noise and interfering transients.

Much stress has been placed on the necessity for using twisted pair as a means to reduce inductive interference in power wiring. It must be realized that benefit from the use of twisted pair only derives as the line characteristic approaches that of a true balanced line. Twisted pair offers no benefit if one side of the system is grounded or if one side of the line contains series impedance components not matched precisely with like impedance components in the opposite side.

4. The use of filters can be helpful in reducing interference if they are properly designed and applied to *individual* load devices in branch power circuits. However, their improper use can produce more harm than benefit, especially if the filter output connects to multipled branch circuits having spike producing switched inductive loads, such as relay windings connected in common with sensitive input interface devices. Further discussion appears in Fig. 3a.

5. Fuses should not be installed in common path feeder lines if at all avoidable. Instead fuses should be installed in individual power branches. Series fuses of course add unwanted impedance and can be considered as series connected noise sources. See Fig. 2.

6. In some power plants one side of the system is grounded, either the positive or negative side for the purpose of stabilizing voltages in the system. In such grounded systems *only one point in the system connecting to ground is to be tolerated.* Preferably the ground point should be at one of the battery terminals. Inadvertent additional grounds at other points in the system cause extraneous interfering currents to flow in conductors existing between the grounds (ground loops). Such interfering currents are, of course, added in series with desired signals. See Fig. 1b.

We have discussed, so far, only the ways and means to live with noise and transient voltage spikes which we encounter in our communications and signal plants. Actually some living conditions could be made more pleasant if some effort could be expended toward elimination or mitigation of the troublesome noise and spikes at their very source. Most of the transient voltage spikes are generated by collapsing magnetic fields when current flow is interrupted in the winding of some inductive device such as a relay. Considering the number of relays in a sizeable signal plant and the number of relay operations that produce harmful spikes, makes one aware of the magnitude of the noise problem. Such spikes are ran-

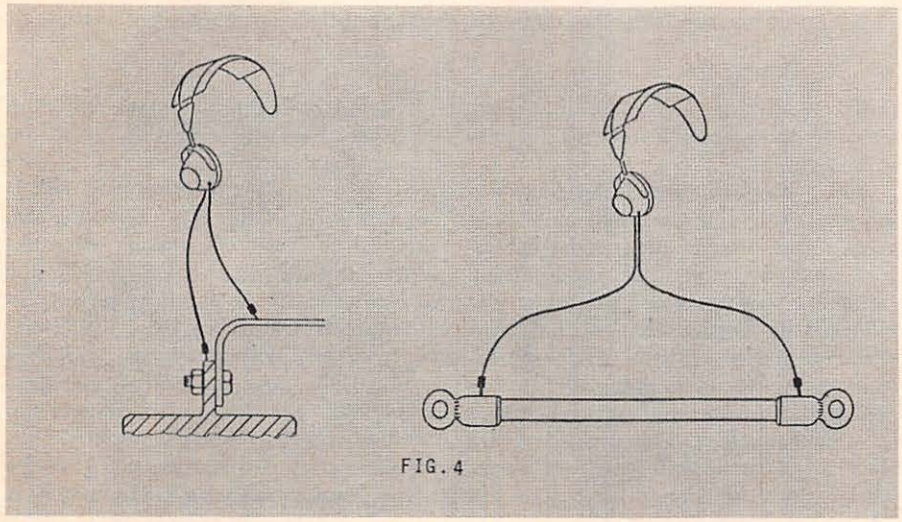

FIG. 4

The telephone receiver is an excellent test instrument which can be used as shown in determining whether connections and connecting straps have been made to properly provide low resistance. If in the above examples, battery changer ripple is present, the faulty connection will produce a steady noise in the telephone receiver. If such noise is not present, the faulty connection manifests itself by producing a click in the telephone receiver as one side of the receiver is alternately connected and disconnected. **Note that nominal operating current must be flowing in the circuitry under test,** otherwise no IR voltage drop will appear across faulty connections. **Noise or clicks will not be observed across properly made connections and straps having desired extreme low resistance.**

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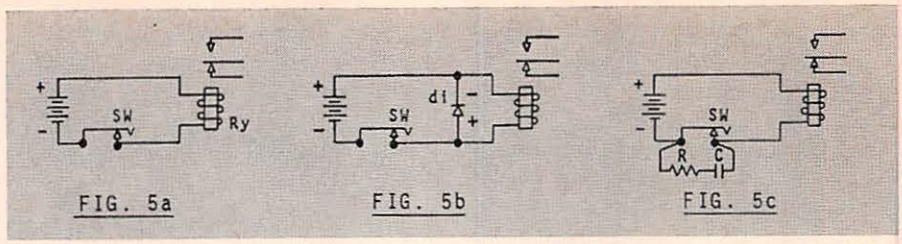

FIG. 5a FIG. 5b FIG. 5c

When the contacts at "SW" are opened in a circuit such as shown in Fig. 5a, the magnetic field in the relay core rapidly begins to collapse. These changing magnetic flux lines cutting the relay winding cause a voltage to be generated in the winding. This voltage is opposite in polarity to the relay's normal operating voltage. The relay winding being open circuited at "SW" is at this stage analogous to any unloaded electric generator. Since no load or sink is connected to the relay winding, the voltage is allowed to develop rapidly into a voltage spike quite high in magnitude. This high voltage spike generally causes an arc to develop at the opened contact "SW" and thus, although generally short lived, the spike may be induced into the system as harmful interference. **It is not uncommon to observe spikes that exceed 1000 volts or higher develop in this manner in the winding of the smallest of telephone type relays, including reed relays.**

Fig. 5b shows an effective and much used method for spike suppression. The diode "di" connected as shown is back biased to the normal flow of current, but when "SW" is opened the reverse potential developed in the relay winding forward biases the diode, allowing current to flow, thus preventing the development of a high voltage spike. The current flowing in this path tends to prevent instantaneous release of the relay on interruption of its operating current. The diode "di" can be replaced with a resistor to effect a reduction in the magnitude of spikes, however, this method causes more current to flow in the circuit's normal operation. Spike reduction and extra current flow developing from this method depends, of course, on the Ohmic value of the resistor.

Fig. 5c offers another effective method for spike suppression. When contacts "SW" are opened in this circuit (Fig. 5c) the voltage spike generated is held to a relatively low value by the load or sink presented by the RC network across the now open contacts "SW". The resistor "R" in this network performs two functions; it prevents an instantaneous inrush of charging current to capacitor "C" when contacts "SW" are opened and it also prevents an instantaneous massive flow of current from the charged capacitor when the contacts "SW" are again closed. Contact welding, caused by massive currents of this nature, is possible and has been observed.

A worthwhile bonus derives from use of these methods for spike suppression in that arcing at the involved contacts is greatly reduced if not entirely eliminated, thereby reducing contact erosion.

Properties of the various devices, used in spike suppression, are dictated by the characteristics of the circuits to be treated; voltages, currents, the magnitude of spikes, etc.

Most methods used in spike suppression cause changes in the treated relay's operating characteristics. See text "effort could be expended toward elimination or mitigation of the troublesome noise and spikes at their very source".

domly produced but their great numbers causes them to appear almost as a planned white noise pattern.

Voltage spikes and noise generated in this fashion can be suppressed to a very great degree by several methods. See Fig. 5 for explanation of methods. All of the methods shown cause changes in a relay's operating characteristics, usually causing the relay to release slowly when its operating current is interrupted. These changes in timing may be cause for consternation when a circuit designer or computer programmer is involved in developing switching sequences which must contemplate critical timing. It should be realized that most relays and relay circuits cannot be designed to energize and de-energize in *extremely* precise and critical time frames. Operate and release timing in relay operation is to a great extent dependent on the stability of power sources, the saturation characteristic of cores, air gaps, etc. Therefore, circuit designers and computer programmers should not assume that relays operate and release with any great precision in timing in the first place. The application of transient spike suppression shown in Fig. 5 will only cause timing change in any given relay's characteristics in a relative fashion, relative to varying conditions in driving power etc., that existed prior to the application of suppression methods.

Spike suppression will be found to afford worthwhile improvement in a plant's operation to the extent that effort must be expended in designing switching sequences and programs that tolerate the timing change that may evolve from the application of suppression methods; or perhaps solid state switching devices could be used instead of inductive relays. This practice (solid state) would not eliminate all problems. The nature of the problems would merely be changed.

It should be noted that in instances where, so called, *vital circuits* are involved *extreme caution* should be exercised in applying spike suppression. Failure of devices used for spike suppression must not interfere with the critical, mandated, *fail safe* character of the involved circuitry.

Communication plant operation dictates that both the maximum reduction of noise at its source and design of the plant to tolerate the existence of any leftover noise must be exercised. This is necessary if chaos is to be avoided; chaos in the form of crosstalk, distorted voice transmission, misdirected dial pulses resulting in wrong numbers, erroneous data handling, etc. It is quite obvious that railroad signal plant has evolved into the same critical and complex state, requiring no less diligence in seeing to its proper functioning.

Hopefully, this paper will not be viewed unfavorably as being merely a biased critique on signal plant practices. In past times and until fairly recently, the signal plant preponderantly consisted of ruggedized low impedance electromechanical apparatus, relays, steppers, etc., all operating in fairly high level current ranges and not even remotely susceptible to low level interference. Therefore, the necessity for

(continued on page 30)

50 YEARS AGO IN

Railway Signaling

Vol. 18 APRIL, 1925 No. 4

Plan for Summer Maintenance

IF signals and interlocking plants are to render efficient and economical service with safety they must be maintained in the proper condition. Many defects of wiring, trunking, worn cranks and pins show up in the spring that have of necessity received little attention during the winter months. Now is the time to plan for handling such heavy repairs as trunking renewals, the replacement of line cables, and broken line insulators, etc. Perhaps the most important work for immediate attention is to inspect the lightning arresters before the spring storms. Those types which may be cleaned should receive this attention and the replaceable parts of other types should be checked and renewed if necessary. At interlocking plants switches and derails should be adjusted, noting the worn cranks and pins causing lost motion. Ordinarily a maintainer is unusually busy during the spring season; therefore, by planning in advance and ordering the materials now to ensure delivery when needed, the work can be handled more satisfactorily.

° ° °

Kicking Holes in the Fence and Breaking Down the Wall

IN recent years there has been criticism from various quarters that the Signal section was too much of a closed technical society and that by building a fence around itself to keep others out it failed to realize that this fence was also keeping the signal engineers from making known the practical benefits of signaling or making positions for themselves on the general staffs of the railroads with broader duties involving the study of traffic and train operation problems.

Within the last three years the Signal section has recognized the need for the more analytical study of train operation and the program at the recent convention on Train Operation by Signal Indication is strong evidence that the idea has grown by leaps and bounds. As a result of the change in attitude of the Signal section, engineering and operating officers are beginning to take a real interest in the application of signaling. George J. Ray, president of the American Railway Engineering Association, outlined the need for co-operation between different departments in his opening address at the convention of that organization in Chicago on March 10, his remarks being so appropriate that they are quoted here:

"We should have more signal men on many of our committees and we should have more members who are not signal men on the signal committee. It is unfortunate that the first day of the Signal section meeting conflicts with the last day of our meeting for we need the signal men and we also believe that they need us.

"To be valuable signal men it is absolutely essential that they have sufficient knowledge of the engineering, maintenance and operating problems to insure recommendations on their own part that will be in keeping with good railroad practice. In my opinion there is no better place to start the accumulation of this knowledge than in the committee work of our association.

"It is generally the duty of the signal engineer to convince the engineering and operating officers that this or that improvement, type of signal, automatic crossing protection or interlocking plant should be used. He cannot expect to be successful unless he familiarizes himself with other branches of the service than his own particular line. I believe that the signal men who are members of our association will agree that it is their duty to convince all of the younger men of the Signal section that they should also become members of the American Railway Engineering Association and take an active part in the affairs of this association."

° ° °

THE **Twenty-fourth Anniversary** of the founding of the Brotherhood of Railroad Signalmen of America was celebrated at Altoona, Pa., on March 7, 1925. T. A. Austin, grand secretary and treasurer of the brotherhood, spoke of the growth and benefits which have been attained in the 24 years since the organization was formed. G. C. Malmsjo, general chairman of the brotherhood on the Pennsylvania system, spoke on the relationships which exist between the brotherhood and the management of the Pennsylvania railroad. R. S. Stewart, division engineer of the Middle division gave an interesting talk on the relations he has had with committees of the brotherhood and also spoke of the safety involved in the work of the craft. A. H. Tasker supervisor of signals on the Middle division talked of the personal contact between the employer and employee and the results which can be attained by the maintenance of confidence between both. The organization was formed in "BO" tower just west of Altoona, Pa., March 7, 1901 there being 14 men present. The brotherhood has now been extended to include most all of the roads in the United States and Canada with 160 local organizations.

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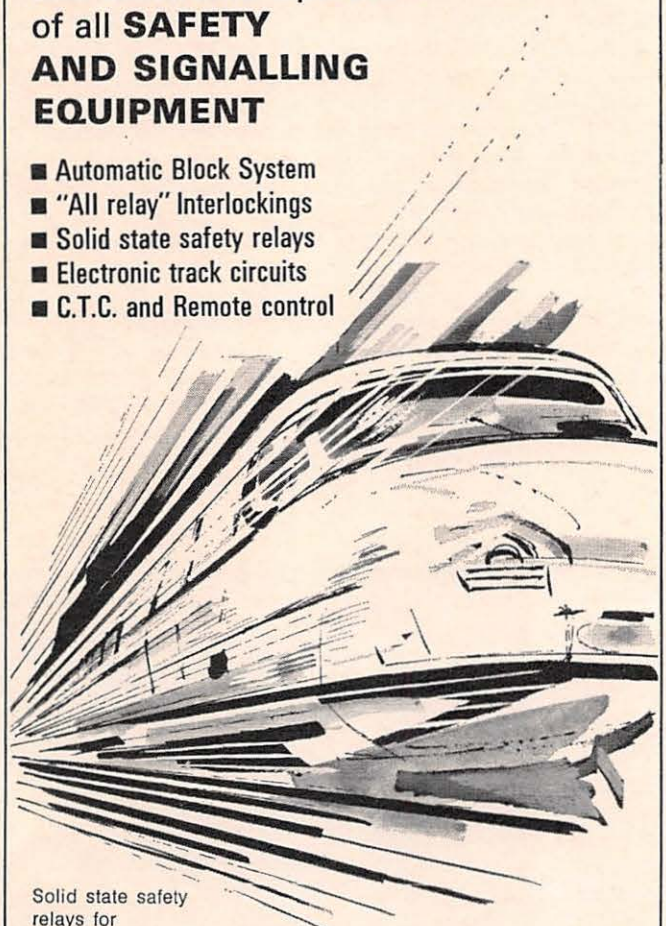
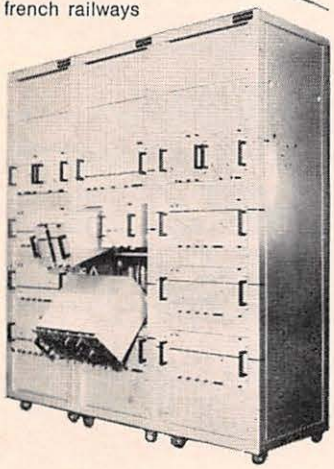
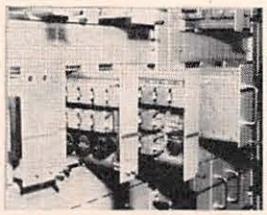


Solid state safety
relays for
french railways





JS-312

SAFETY - RELIABILITY

Circle 9 on Reader Service Card.

Noise

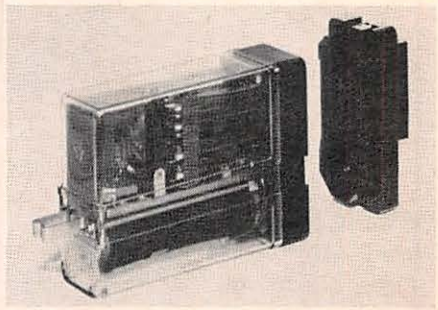
(continued from page 28)

interference elimination was not at all rigorous, and in many cases such problems did not even exist. Whereas, communication plant practices have always, of necessity, had to be designed to accommodate extremely rigorous requirements in noise/interference elimination.

It has been said that railroad signal power levels and practices are applicable to the left hand side of the decimal point and communications levels and practices to the right hand side. This statement is no longer an accepted axiom. Signal plant has for some time now employed complex, delicate and sensitive apparatus requiring extreme caution in plant design and operating practices that extend well in to the right hand side of the decimal point. This you had better believe.

Note: This discussion is concerned primarily with low current level, non vital signal plant apparatus and circuitry commonly used in sensing field conditions and generating control functions as is required in automated RR yard operation and other similar operations. Not to be confused with heavy prime mover type power plants such as may be required in the operation of electric switches and retarders. However, some of the practices discussed are applicable in the latter case.

Product News



New timer is for railway signaling

A new electronic fail-safe timer for railway signaling has been developed by ML Engineering Ltd., of England. According to the manufacturer, fail-safe signaling principles have been rigidly adhered to in the design of the unit, which incorporates a new timing method for which world patents have been applied.

The timer module is mounted within a single-width British Railways Board 930 series plug-in relay case which also contains a standard signaling 8-contact

relay. The combination of an 8-contact relay and time module within the same single-width plug-in case permits simplification and allows considerable savings in associated relay circuits for many applications.

In a typical "slow to operate" form of the unit, timings in the range of 0 to 124 seconds in four-second increments are obtained by simple external straps. The relay is externally strapped to "follow" the operation of the static module and provides eight separate signaling-type contacts in any standard combination of backs and fronts. *ML Engineering (Plymouth) Ltd. Circle 107 on Reader Service Card*

Portable track car can carry 5,000 lbs.

A portable, lightweight, all-purpose, four wheel track car for use by maintenance of way and signal forces is now available. The new track car is built of a heavy duty aluminum welded frame which, according to the manufacturer, is capable of transporting up to 5,000 lbs. The platform measures 52½ by 47 in. and rides 7½ in. above the rail. There are four wheels of cast aluminum with sealed and pre-lubricated roller bearings. Each wheel is insulated to prevent track shunting. *Safetran Systems Corp. Circle 108 on Reader Service Card*

VOM multimeter has wide range

The 260-6XL and 260-6XLP Volt-Ohm-Milliammeters feature additional range coverage including low power ohms and extra shock and drop resistant construction. A total of 33 ranges are provided, with extra voltage and current ranges not usually found in VOMs. The two low power ohms ranges are in addition to the conventional resistance ranges. The extended measuring capability of the XL series adds to its usefulness for designers, field service engineers and manufacturing personnel working with solid-state devices and equipment. *Simpson Electric Co. Circle 109 on Reader Service Card.*

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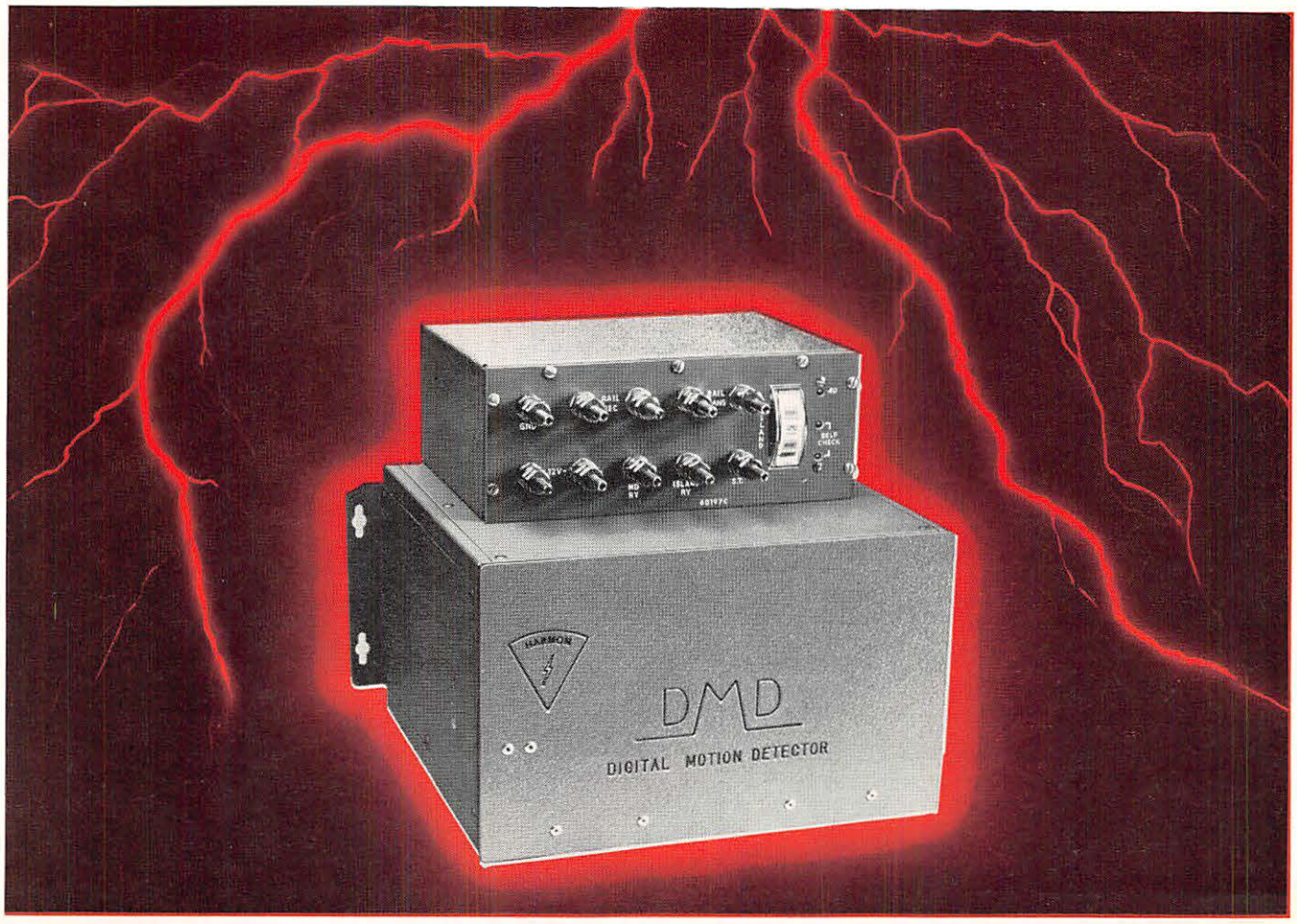

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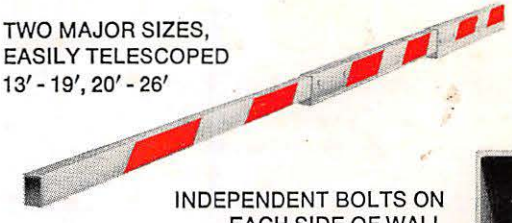

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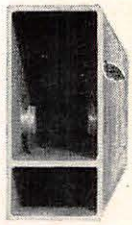

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